Digital Clinic System

By

Norsafina binti Bahari

WET000176

Session 2003/2004

Bachelor of Information Technology (Multimedia)

Faculty of Computer Science & Information Technology

University Of Malaya

Abstract

Web accessibility will be an essential component of the services that future clinics should provide for clients. The clinic's site will generate patient loyalty by providing convenient access (24 hours a day, 7 days a week) to the clinic's services, location and hours and provide them with immediate access to a wealth of contemporary, health related information.

Following from that, Digital Clinic System has been developed to generate awareness and patient referrals and raise the clinic's image by demonstrating the leading edge, technological proficiency. Digital Clinic System allows patients to register and make an appointment with the doctor through Internet. On the administrator and doctor side, an application will be developed in a local environment, which provides more secure than online to maintain the system.

To achieve the above requirements, the system is run in web-based Three-Tier client/server architecture. The backend include the database server and web server. Database server operates the "data access logic". The Microsoft Access store and process all data of the clinic and patients. The web server manages the operation of the LAN. It handles and distributes the requests of clients. IIS 5.0 will be used to connect front end and the web server, so that ASP can be run to provide and environment for the script of the web server. The front end includes computer of doctors and staffs. Users access the system by using web browser.

Acknowledgement

Firstly, I would like to thankful to God because with his consent, I can complete my project.

I would like to thank to individuals who get involve in assist to complete this project. Without their commitment and assistance, this project may be is not successfully complete. In fact, this is my first experience in developing a system as individual.

A thousand thanks to my supervisor, Mr. Amirrudin that always helps me and guides me along project implementation. Never forget to my moderator, Mrs. Nurul Fazmidar that willing gives comments and suggestion to develop better system.

For my mom and my sister, thank you so much for your support and motivation. And also to Dr. Mohd Tasnain Sabri that is willing to spent time to be interviewed and gives information that are needed.

Last but not least, thank you to my friends that give guidance and advice and also your support too.

Thank you.

Table of Content

List of Figure

List of Table

Chapter 1: Project Introduction

1.1 Project Overview

Healthcare providers are nowadays being forced to streamline operations through more efficient and cost effective office procedures. Automating these tasks results in time, material and labor savings, providing a positive return on your investment.

Consider the following clinic scenario: When a patient makes an appointment with a doctor, the doctor should be able to retrieve information about the patient instead of going through loads of paper work. In addition, authorized personnel should be able to add, retrieve and update information anywhere anytime. Handling and processing this information might be very critical depending on the application.

Digital Clinic System is a web-based solution specially designed to allow a more efficient and effective control over the clinic's resources, time management and catering to a patient's requirement. It eliminates as many time-consuming tasks as possible, with features such as patient information management, appointment management, and other aspects of a clinic operation.

Digital Clinic System eliminates all manually handled procedures, streamline administrative workflow and provide complete web-based clinical records.

1.2 Project Objective

The basic objectives have been drawn in developing the Digital Clinic System. These objectives are shown below:

- Computerize the clinic administration system.
- To become a paperless, efficient and effective clinic.
- Record and systemize the information of patients.
- Provide a user-friendly graphical user interface (GUI) to users.
- To have a secure, reliable, online clinical information system.
- To connect and manage distributed information resources.

1.3 Project Scope

Each year, more and more patients and prospects are using the web to source educational material, research health concerns and locate clinic in their area.

Through Digital Clinic System, can increase the loyalty of existing patients by providing valuable health information, generate awareness and patient referrals and substantially raise clinic's image by demonstrating leading edge, technological proficiency.

Digital Clinic System is the wave of the future in clinic management, designed to reduce promotional costs, save time in communicating with patients through online registration and appointment bookings.

The scopes of the Digital Clinic System are:

1. Develop an online registration system for a patient
2. Develop a function that allows patients to make medical appointment.
3. Develop a function that allows patients to change their information themselves, which is stored in the database.
4. Develop a database system to house all data pertaining to the system.
5. Develop a collection of interactive web pages as interface of this project.
6. Develop a function that allows administrator can add, edit and delete user profile or upload and retrieves files.
7. Develop a function that allows doctors schedule their daily work systematically.
8. Develop a function that allows users make a diagnosis themselves for unserious problems.

1.4 System Constraints and Limitation

There are some constraints and limitations in the development of the clinic administration. Due to the complexity of the actual system, there is no way for me to develop a complete functional module. I have chosen to develop the main feature of the system and have been left out some features in human resource management like employee salary management.

I have designed the system based on some case studies, which means that user will be the flow of the system from a case we have planned.

1.5 Project Schedule

Project scheduling cursors of the whole development activities is carefully planned out to achieve a systematic progress and ensure on-time delivery of the product. It is important to have a project schedule as it acts as a time management and control to the developer. This will make sure that he/she is in route of the direction of the project. Table 1.1 shows the project schedule in Gantt chart.

Table 1.1: Project Schedule of Digital Clinic System

Activities	Feb	March	April	May	Jun	July	Aug	Sept	Oct	Nov
Investigation Phase										
• Project Definition										
Analysis Phase										
• Gathering Project Information										
• Identify System Requirement										
• Identify Hardware & Software Requirement										
• Presentation										
Design Phase										
• Database Design										
• Interface Design										
• Web Design										
Development and Implementation Phase										
• Database development and testing										
• Web development and testing										
• User documentation										
• System Testing										
• Installation System										
Operation Phase										
• Maintenance										

1.6 Expected Outcome

The expected outcomes of the proposed system are based as below:

1. **Efficient Customer Relationship Management**

   Email the valued patients in the shortest time once an appointment has been rescheduled. This emphasizes the high level of priority to treat the patients, which in turn strengthens doctor's relationship with his/her patients.

2. **Accessibility anywhere with Internet**

   Authorized personnel can have the access to all of the data wherever they are with Internet connectivity. The patients can also diagnose themselves for unserious problems and get appropriate prescriptions.

3. **No hassle of training**

   No training is needed to be special conducted to learn how Digital Clinic System works. Digital Clinic System is extremely easy to use in which all-new staff will be able to pick up in the shortest time.

4. **Centralized Patient Information Storage**

   Patient's information can now be stored in a paperless and organized manner. Retrieval and management of all of patient's information will no longer be a difficult task.

5. **Appointment Tracking**

No more flipping through the appointment book to keep track whether patients kept their appointments, rescheduled or missed their appointments. Digital Clinic System software keeps track of everything for doctor and provides immediate notification to patient through email when an appointment has been changed or delayed.

1.7 Summary

This chapter is to explain with in more detail about Digital Clinic System. The overview of the project, objectives of the project, scope of the project and the limitation of project are given. The project schedule is as a guideline to develop the project.

Chapter 2: Literature Review

2.1 Clinic Management System

Clinic Management system is developed to facilitate management of patient's information for example the registration of patients, patient's information storage, access to patient's information and information that relating to the clinic. Clinic Management System is divided to 2 separated management systems:

1. Manual Clinic System
2. Online Clinic System

2.1.1 Manual Clinic System

Human manages this manual system. Patient's record will be kept in the patient's file and then is arranged in the shelf according to patient's name. This will cause so complicated to access the patient's information if there is same patient's name. This type of system is seldom use now because it takes time to accomplish the task and the system is also not very reliable.

From the observation to the manual clinic system, gives me a conclusion there are many steps that must be followed by a patient to get a treatment with a doctor. The steps are:

1. **Patient Registration**

   Each patient needs to be register first before he/she can meet the doctor. For a new patient, he/she must gives his/her personal information such as full name,

address etc to the clinic staff. This personal information will be record into patient file and then it will be arranged into a shelf following to the reference number that is viewed at the patient file. This reference number must be same as reference number at the patient card that will be kept by the patient. This is because to easy the staff traces the patient file record in the future.

2. **Tracing Patient File Record**

Once a patient already has registered to the clinic, he/she does not need to do so. He/she just needs to show his/her patient card to the clinic staff. Then the clinic staff will find his/her record file following to the reference number that viewed at the patient card. This manual system might give rise to find the record file if the patient did not bring together or lost his/her patient card.

3. **Waiting System**

After the registration and finding the patient file record process, the patient must be waiting for a while before his/her turn arrive except for a serious case. First come, first serve.

4. **Get a Treatment**

After the patient turn arrived, he/she can meet the doctor to get his/her treatment. The doctor will check the patient and record the patient illness into patient file. Then, the file will pass to the staff to get the medicine following to doctor suggestion.

5. Get Medicine

The final process is to get the medicine. The patient needs to wait again for a while before his/her will be called to take his/her medicine.

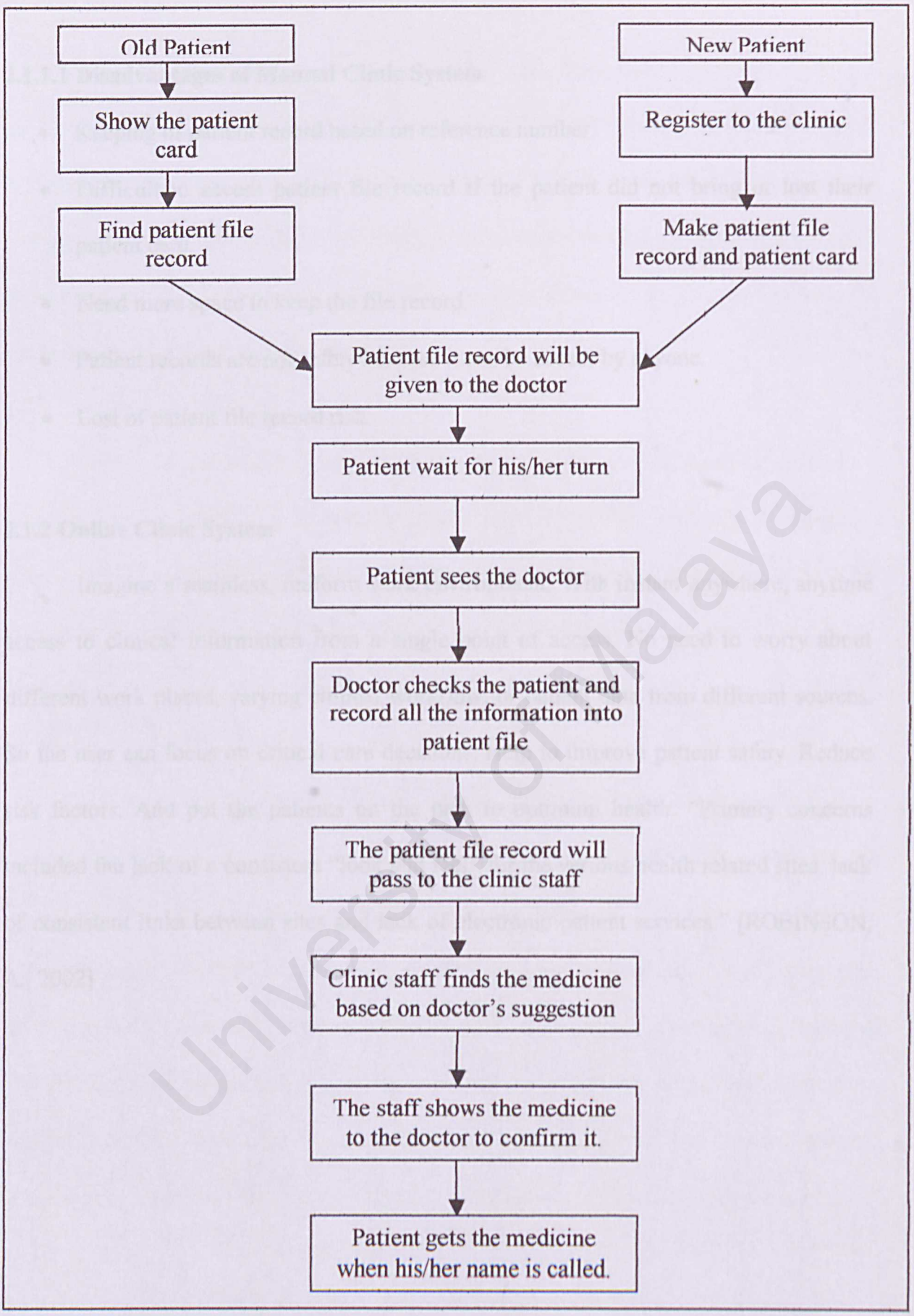

Figure 2.1: Manual Clinic System Process

2.1.1.1 Disadvantages of Manual Clinic System

- Keeping of patient record based on reference number.
- Difficult to access patient file record if the patient did not bring or lost their patient card.
- Need more space to keep the file record.
- Patient records are not safety because it can be access by anyone.
- Lost of patient file record risk.

2.1.2 Online Clinic System

Imagine a seamless, uniform work environment. With instant anywhere, anytime access to clinical information from a single point of access. No need to worry about different work places, varying clinical workflow, or patient data from different sources. So the user can focus on critical care decisions. Help to improve patient safety. Reduce risk factors. And put the patients on the path to optimum health. "Primary concerns included the lack of a consistent "look and feel" for the various health related sites, lack of consistent links between sites and lack of electronic patient services." [ROBINSON, A., 2002]

2.1.2.1 Total Hospital Information System in Selayang Hospital

3 Com Asia Ltd, a networking innovator that offers effortless communication and information access has participated in helping RM 530 million state-of-the-art Selayang Hospital (SH) in implementing Total Hospital Information System (THIS), which is said to be the world's and Malaysia's first in utilizing information technology in all aspects of its operation to provide seamless patient care.

The Total Hospital Information System in Selayang Hospital is an integration of clinical, administrative and financial systems. The clinical is made up of Hospital Information System (HIS) and Picture Archiving Communication System (PACS). The HIS is made up of various applications (Person Management, Scheduling, Order Management, Clinical Documentation, PIS, LIS, RIS, and so on).

The Administration and Finance System as back end is integrated with the HIS so that any chargeable procedures or tests performed on the patients will automatically trigger the generation of the bills. With PACS, the system is also interfaced with the various x-ray machines. So the challenge here is that the integration is so deep and extensive that it is not only between software applications but also between applications and modalities or equipment especially in the radiology, laboratory, intensive care and operating theatres where the system is interfaced directly into the equipment and what ever data or image produced by such equipment will go directly on-line into the system.

In summary, patients' medical records, guidelines and clinical protocols are instantly available and can be assessed in one integrated workstation at any place and at any time in the hospital, provided that the user has proper authority to access the information. Being an electronic hospital that has taken the initiative to implement THIS, Selayang Hospital has become a showcase to the rest of the world.

2.1.2.2 Digital Clinic System

Digital Clinic System is developed to computerize some of the daily jobs of Manual Clinic System.

To computerize the Manual Clinic System, human factor is the most important issue. The culture of the Manual Clinic System is quite conservative and almost of the operations in clinic is still following traditional manual methods. As results, there is a difficulty to make the doctors and staffs to adapt to the computer system instead of using their conventional methods.

At this stage, this project is not to raise a revolution on Manual Clinic System that changes peoples' traditions, but to convert almost of the manual operations into computerized ones only. The methods, terminology and steps of the Manual Clinic System will be preserved as possible, so that people can enjoy the automatic, accurate and effective computer system with minimum learning.

2.2 Clinic System that Exist

2.2.1 Jackson Hospital (http://www.jackson.org/)

This website was designed to provide user with a wide array of information about Jackson Hospital's services and programs. This hospital connectivity service is for current and future patients that allow the patients to contact their doctor via phone or email message. This website also provide the patient info that allow patients to quick access to information that might help patients feel more comfortable and accustomed to their hospital, their advanced facilities, and their caring physicians.

Besides that, they provide a calendar event system to review the important events in Jackson Hospital to notify the users. However, this system is not secured for patient's medical information because there is not provide the login ID and password to access the system. This enables the users achieve the other patient's medical information. The patient's records are not safety. This may the personal information of patients is revealed.

2.2.2 Primary Health Care (http://www.pcdom.org.my/aboutus.htm)

National Vision for Health is state in [Primary Care Doctors' Organization Malaysia]. The main objective of this website is to define, promote, maintain and strengthen the role of the general practitioners and other primary care / family physicians vis-à-vis other practitioners within the country's health care system, to ensure that every Malaysian family has a family / general practitioner as career and counselor as we move towards 2020.

The Primary Health Care Pilot Project illustrates the commitment to the use of information and communication technology (ICT) by medical practitioners towards a mission of improving the quality of care to patients. This is achieved by improving the capacity and quality of the Primary Care Doctors (GPs) through information sharing via an electronic community of GPs, their clinic staffs and nurses. The efficiency of their work processes will be strengthened through the application of decision support system using evidence-based learning made possible only by adopting current information and communication technology.

PCDOM Intranet Validation System to function as an intranet for Primary Care Doctors only. Access to the various topics is password protected, depending on who can have access to what information. Chat forums, mailing lists, bulletin boards, etc. provide the platform for doctors to communicate and exchange ideas and views. At the same time it is also a very effective method for learning

2.3 Consideration of Technologies

2.3.1 Consideration of Operating System

2.3.1.1 Windows NT

Windows NT was designed to be a robust, reliable operating system that could be easily maintained and that could be extended to take advantage of new technologies as they were developed. The system includes a highly functional executive that executes in kernel mode, and provides native system services. The executive provides the sole, secure entry point into the system that there are no back door entry points that could compromise security or damage the system in any way. In addition, the design includes a layer of protected system services that function in user mode between the application layer and the operating system. This modular approach allows additional crucial services to be added that with no change to the executive layer. Each major executive subsystem has been extensively documented to ensure that standard coding practices are used and that all features adhere to the system design and is maintainable over time.

2.3.1.2 Windows 2000 Professional Edition

Windows 2000 Professional is the Windows operating system for business desktop and laptop systems. It is used to run software applications, connect to Internet and intranet sites, and access files, printers, and network resources.

Built on Windows NT technology and the easy-to-use, familiar Windows 98 user interface, Windows 2000 Professional gives business users increased flexibility. The integrated Web capabilities let user connect to the Internet from anywhere, at anytime—

giving company access to host of flexible, cost-effective communications options. In addition, broad peripheral and mobile computer support make Windows 2000 Professional an ideal operating system for a workforce that increasingly relies on notebook computers. Further, support and administrative staff will particularly appreciate the reliability and manageability enhancements that make desktop management simpler and more efficient. Windows 2000 Professional lets:

- **Work the way you did with Windows 98, only much faster.** Combine the ease of Windows 98 with the manageability, reliability, and security of Windows NT, at speeds 30 percent faster than Windows 98 on PCs with 64 MB of RAM or more.
- **Communicate, share information, and use the Internet quickly and easily.** With integrated support for Internet-enabled applications, business software developers incorporate the new ways to create and share information made possible by the Internet.

2.3.2 Consideration of Server Side Scripting

2.3.2.1 Active Server Pages (ASP)

Microsoft Active Server Pages (ASP) is a *server-side scripting* environment that can use to create and run dynamic, interactive Web server applications. With ASP, programmers can combine HTML pages, script commands, and COM components to create interactive Web pages or powerful Web-based applications, which are easy to develop and modify.

2.3.2.1.1 Why ASP?

Fast execution is one of the major reasons ASP is chosen to develop Digital Clinic System. Time saving is really important to the users. Users prefer online clinic mostly due to the convenient and time saving provided by the system.

ASP enables dynamic web design effortlessly. This feature makes the web applications easy to maintain and modify to meet the new needs and requirements. ASP language is faster to write than other conventional web page design method. When come to the time frame consideration, ASP properly is the appropriate technology used to develop Digital Clinic System since ASP is easy to learn and use if compare to CGI. ASP application is browser independence because it is server side scripting.

The reason why choose ASP are shown below:

1. **For the HTML Author**

   For the HTML author, he/she will find that server-side scripts written in ASP are an easy way to begin creating more complex, real-world Web applications. If he/she has ever wanted to store HTML form information in a database, personalize Web sites according to visitor preferences, or use different HTML features based on the browser, he/she will find that ASP provides a compelling solution. For example, previously, to process user input on the Web server you would have had to learn a language such as Perl or C to build a conventional Common Gateway Interface (CGI) application. With ASP, however, you can collect HTML form information and pass it to a database using simple server-side scripts embedded directly in your HTML documents.

2. For the Experienced Web Scripter

Since ASP is designed to be language-neutral, skilled at a scripting language such as VBScript, JScript, or PERL, already know how to use Active Server Pages. In ASP pages also can use any scripting language for which installed a COM compliant scripting engine. ASP comes with VBScript and JScript scripting engines, also can install scripting engines for PERL, REXX, and Python, which are available through third-party vendors.

3. For the Web Developer and Programmer

For develop back-end Web applications in a programming language, such as Visual Basic, C++, or Java, ASP a flexible way to quickly create Web applications. Besides adding scripts to create an engaging HTML interface for application, developer and programmer can build their own COM components. They can encapsulate their application's business logic into reusable modules that they can call from a script, from another component, or from another program.

4. The Active Server Pages Model

A server-side script begins to run when a browser requests an **.asp** file from Web server. Web server then calls ASP, which processes the requested file from top to bottom, executes any script commands, and sends a Web page to the browser. Because the scripts run on the server rather than on the client, Web server does all the work involved in generating the HTML pages sent to browsers.

Server-side scripts cannot be readily copied because only the result of the script is returned to the browser. Users cannot view the script commands that created the page they are viewing.

2.3.2.2 Java Server Pages (JSP)

Java Server Page is an extension of servlet technology. Java Server Page simplifies the delivery of dynamic Web content. They enable Web applications programmers to create dynamic content by reusing predefined components and by interacting with components using server side scripting. Java Server Page programmers can reuse Java Beans and create custom tag libraries that encapsulate complex, dynamic functionality. Custom-tag libraries even enable Web page designers who are not familiar with Java to enhance Web pages with powerful dynamic content and processing capabilities.

In many ways, Java Server Pages look like standard XHTML or XML documents. In fact, JSPs normally include XHTML or XML markup. Such markup is known as fixed-template data or fixed-template text. Fixed-template data often help a programmer decide whether to use a servlet or a JSP. Programmers tend to use JSPs when most of the content sent to the client is fixed template data and only a small portion of the content is generated dynamically with Java code. Programmers use servlets when only a small portion of the content sent to the client is fixed-template data. In fact, some servlets do not produce content. Rather, they perform a task on behalf of the client, and then invoke other servlets or JSPs to provide a response. Note that in most cases, servlet and JSP

technologies are interchangeable. As with servlets, JSPs normally execute as part of a Web server. The server often is referred to as the JSP container.

2.3.2.3 JSP Vs ASP

The following is the comparison between JSP and ASP:

Table 2.1: Comparison Between JSP and ASP

JSP	ASP
Uses pure Java, takes full advantage of its object oriented nature	Uses scripting languages (VBScript, JavaScript) to handle much of its server-side programming.
Cross-platform support is strength.	Works on other platforms with add-ons, but such combinations can't touch JSP's broad support on UNIX.
Maintains session through the HTTP session object.	Uses the session object to manage user state information, allowing the server to keep track of the user and the activities they're doing on the site.
Uses the Servlet Context Object, which is equally similar to the way	Uses the application object, which is similar to the session object to

sessions are handled to maintain site-wide application value while each client uses and manipulates the same copy of these values.	maintain site-wide application values.
JSP has edge in platform compatibility, but it forced user into all-Java Programming Model. It can only make native calls to Java classes or Java Beans, which is written only in Java.	ASP can call COM object written in any language-provided they run on windows.
Java uses a technology called JDBC (Java Database Connectivity) for database access.	For database connectivity, ASP sets up and uses ODBC connections through ADO.

2.3.3 Consideration of Web Scripting Languages

Web scripting languages, also known as browser-dependent languages they are full fledge programming languages that cannot create stand-alone applications. These languages require a host application, in this case a web browser, to provide functionality to the scripting languages. The major web scripting languages are JavaScript and VBScript.

2.3.3.1 JavaScript

JavaScript scripting language, which facilitates a discipline approach, is to design computer programs that enhance the functionality and appearance of Web pages.

The JavaScript can be implemented for Web-based application. It's providing the programming foundation for both client-side scripting, which makes Web pages more dynamic and interactive, it provides the server-side scripting.

2.3.3.2 VBScript

Visual Basic script (VBScript) is a subset of Microsoft Visual Basic used in World Wide Web XHTML documents to enhance the functionality of a Web page displayed in a Web browser. Microsoft's Internet Explorer Web browser contains a VBScript scripting engine (i.e., an interpreter) that executes VBScript code. VBScript is particularly valuable when used with Microsoft Web servers to create Active Server Pages (ASP) – a technology that allows a server-side script to create dynamic content that is sent to the client's browser.

2.3.3.2.1 Why VBScript?

After consideration several languages that are available in the market, VBScript seems to be the most desirable scripting language. It is because VBScript is the default scripting language for ASP. Furthermore, it is also much easier to pick up the scripting languages, as most of us have already known Visual Basic. Time frame should always be considered to make sure the system would be completed within the time frame. In addition to it, it is easier to implement as well as it does not require any additional

software besides Windows NT Server 4.0 and Internet Information Server (IIS). Besides, VBScript is a fast, portable, lightweight interpreter for use in WWW browser the web application. However, Jscript will only be used if some functions could not be supported with VBScript.

2.3.3.3 Hyper Text Markup Language (HTML)

To publish information for global distribution, one needs a universally understood language, a kind of publishing mother tongue that all computers may potentially understand. The publishing language used by the World Wide Web is HTML (from HyperText Markup Language).

HTML gives authors the means to:

- Publish online documents with headings, text, tables, lists, photos, etc.
- Retrieve online information via hypertext links, at the click of a button.
- Design forms for conducting transactions with remote services, for use in searching for information, making reservations, ordering products, etc.
- Include spread-sheets, video clips, sound clips, and other applications directly in their documents.

2.3.4 Consideration of Web Server

2.3.4.1 Microsoft Internet Information Server 4.0

IIS version 4.0 includes:

a) **Integration with Windows NT Server:**

- IIS provides a platform for building and deploying Web-based applications.
- IIS brings the security of Windows NT Server to your Web site, without additional configuration, to protect your information with a single user directory and the ability to log onto a network.
- Windows NT Server combined with IIS provides an integrated set of tools for running and managing your entire network, Web, and application services, reducing training time for administrators.

b) **Publish and share information:**

- Create professional-quality Web pages and publish entire sites, without knowing any HTML, by using wizards and templates.
- Publish information to the Web using a Web browser, the Web publishing wizard, or FTP.
- Share files and data on Windows NT, Novell NetWare and UNIX servers, and more than 55 databases, including Microsoft SQL Server, Oracle, and Sybase databases.
- Search for content in HTML and Microsoft Office document types, and multiple languages.

c) **Build and run web applications:**

- Protect applications and Web sites against failure from misbehaving components or Web applications on the server, by running them in separate memory spaces, a feature known as process isolation.
- Create scalable Web applications using built-in distributed application services that automatically scale to serve thousands of simultaneous users.
- Developers can use languages they know to develop components and applications.
- Developers familiar with desktop applications written in any language can write and debug components and applications that run on the server.

Use the integrated Java Virtual Machine to provide an environment for running Java components on the server with ASP pages.

2.3.4.2 Microsoft Internet Information Server 5.0

Microsoft Windows 2000 Server with Internet Information Services (IIS) 5.0 offers performance gains and higher availability for your Web servers and sites. With tighter integration between the operating system and IIS, you can now tune your servers to perform much faster and more efficiently than in previous versions.

This document is intended for Web server administrators charged with monitoring and tuning Web sites running on Windows 2000 and IIS. Although there is some discussion of Web application testing and tuning here, this document's primary audience does not include Web application developers.

This document discusses an approach to tuning the performance of your Web servers. It also addresses why performance tuning is important and discusses hardware, software, and testing issues involved in tuning your IIS 5.0 Web servers. Finally, it includes a short discussion of tools you can use to monitor and test server performance. While there is a discussion of some of the more prominent issues in tuning Web applications, this document does not delve into this issue exhaustively. For links and references to this and other topics, see the Resources section of this document.

2.3.5 Consideration of Database

2.3.5.1 Microsoft SQL Server 2000

Data warehouse serve the needs for an enterprise; in contrast, data marts serve specific business units or functions. It help user to better understand the information and have a new way to gain insights, see patterns and trends and make a better business decision.

Microsoft SQL Server 2000 is a full-featured relational database management system (RDBMS) that offers a variety of administrative tools to ease the burdens of database development, maintenance and administration.

2.3.5.2 Microsoft Access 2000

One of the easiest ways of creating a database is by using Microsoft Access 2000. This is because it has an easy menu driven interface that lets the user issue commands without an in depth understanding of Access. At its most basic level, Access can be used to develop simple personal database management system.

Access is an excellent platform for developing an application that will run a small business. Its wizards allow developers to quickly and easily build the foundation of the application. The ability to build code modules allows developers to create code libraries of reusable functions, and the ability to add one behind forms and reports allows them to create powerful custom forms and reports.

2.3.6 Consideration of Software Development Tools

2.3.6.1 Macromedia Dreamweaver

Macromedia Dreamweaver is a professional HTML editor for visually designing and managing Web sites and pages. Whether you enjoy the control of hand-coding HTML or prefer to work in a visual editing environment, Dreamweaver makes it easy to get started and provides you with helpful tools to enhance your Web design experience.

Dreamweaver includes many coding tools and features: an HTML, CSS, and JavaScript reference, a JavaScript Debugger, and code editors (the Code view and Code inspector) that allow you to edit JavaScript, XML, and other text documents directly in Dreamweaver. Macromedia's Roundtrip HTML technology imports HTML documents without reformatting the code—and you can set Dreamweaver to clean up and reformat HTML when you want it to.

Dreamweaver's visual editing features also let you quickly add design and functionality to your pages without writing a line of code. You can view all your site elements or assets and drag them from an easy-to-use panel directly into a document. Streamline your development workflow by creating and editing images in Macromedia Fireworks, then importing them directly into Dreamweaver, or by adding Flash objects you create directly in Dreamweaver.

2.3.6.2 Macromedia Dreamweaver Ultradev

Macromedia Dreamweaver Ultradev is a professional environment for building Web applications. A Web application is a collection of pages that interact with each other and with various resources on a Web server, including databases.

Ultradev is also a professional editor for creating and managing Web sites and pages. Because it incorporates all of Dreamweaver's page design and site management tools, Ultradev makes it easy to create, manage, and edit cross-platform, cross-browser Web pages.

Ultradev is fully customizable. We can create our own objects, commands, and server behaviors, modify menus and keyboard shortcuts, and even write scripts to extend Ultradev with new actions, behaviors, and property inspectors.

To build Web applications in Ultradev, we need the following:

- A Web server
- An application server that runs on your Web server, or a Web server that doubles as an application server, such as Microsoft's Personal Web Server (PWS) or Internet Information Server (IIS)
- A database or database system
- A database driver that supports your database system

The exact requirements vary depending on whether you use Ultradev to create Active Server Pages (ASP) applications, ColdFusion applications, or Java Server Pages (JSP) applications.

Here are typical system configurations of ASP developers working with Microsoft Access databases:

Table 2.2: Typical system configurations for ASP developers

Ultradev system	Web server	App server	Database driver
Windows 95, 98, NT Workstation	PWS running locally	PWS running locally	Microsoft Access Driver (ODBC)
Windows NT Server, 2000	IIS running locally	IIS running locally	Microsoft Access Driver (ODBC)
Macintosh	IIS running remotely	IIS running remotely	Microsoft Access Driver (ODBC)

2.4 Summary

As a whole, literature review is very important to the development of project as all information relevant to the project are thoroughly analyzed and reviewed. Next, we shall move on to Chapter 3 where we discuss the methodology for the project, as well as recognizing the requirements of the system.

Chapter 3: Methodology

3.1 Introduction

Methodology and system analysis are the earliest phases in development system. It involves identification of functional and non-functional requirement. This chapter focuses in the aspects of analyzing the information obtained so hat it can be incorporate into the system. System analysis is the process of understanding broader aspects of the system that would be required to solve problems. The overall emphasis is to gather information obtained and use this information to consider other alternatives possible before core holding that best solution for system. The analysis is done first to obtain requirements for the system. Then methodology is included into this chapter to see how the project will be developed. Synthesis is done from existing system and some features will be adopted into the propose system. Tools and languages for development will be discussed and determined for the development of the project.

3.2 Definition of Methodology

Methodology is defined as a set method that is used in a particular area of activity. Methodology in system development means a methodical approach to project system planning, analysis, construction and evolution.

3.3 Waterfall Model with Prototype

3.3.1 Overview

Waterfall model with prototype, illustrated in figure 3.1 is the technique, which helps to control the trashing by including prototyping that enhance understanding. A prototype is a partially developed product that enables customer and developers to examine some aspect of the proposed system and decide if it is suitable or appropriate for the finished product.

Often, the user interface is built and tested as a prototype, so the users understand what the new system will be like and the designers get a better sense of how the users like to interact with the system.

The prototyping model:

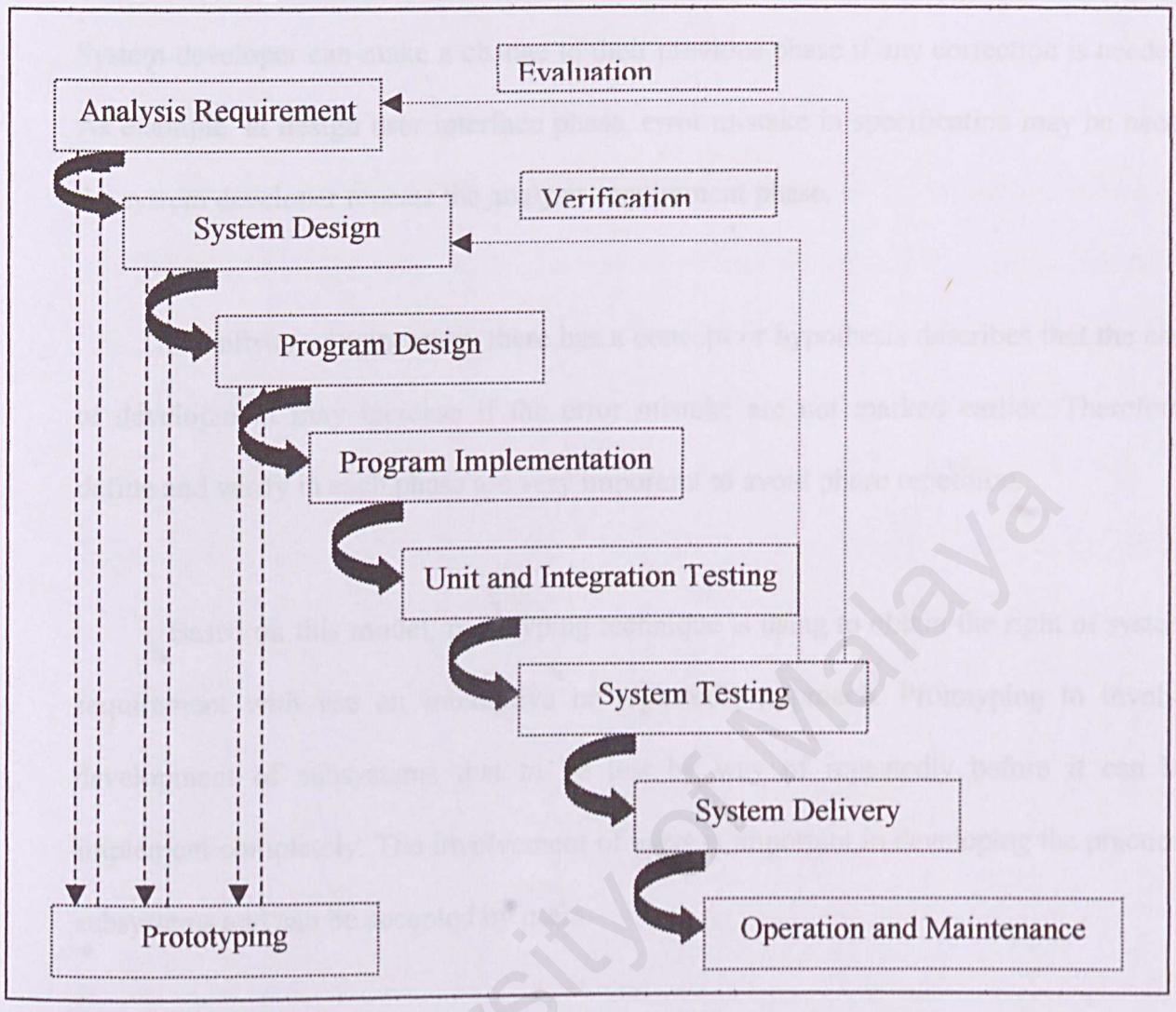

Figure 3.1: Waterfall Model with Prototype

3.3.2 Waterfall Model with Prototype Approach

Waterfall model with prototype was build by Royce at 1970. This model needs the developer of system to commit the analysis requirement first. System requirement was determined, defined and was checked carefully to be documented. After the user verifies the specification, the following phases are committed.

This model allows feedback and repetition in development system process. System developer can make a change to their previous phase if any correction is needed. As example, at design user interface phase, error mistake in specification may be needs the system developer repeats the analysis requirement phase.

In software engineering, there has a concept or hypothesis describes that the cost of development may increase if the error mistake are not marked earlier. Therefore, define and verify in each phase are very important to avoid phase repetition.

Based on this model, prototyping technique is using to obtain the right of system requirement with use an interactive or repeatedly approach. Prototyping to involve development of subsystems that to be test by way of repeatedly before it can be implement completely. The involvement of users is important in developing the practical subsystems and can be accepted by users.

If there is any error and the users are not satisfied with the subsystem, system developer go through to the analysis requirement phase to design the subsystem according to the specification needed by the users. The new subsystem will be implemented again. These procedures will be done repeatedly until the users are totally satisfied with the system.

The prototype's procedures are including the several important steps. The system developer will design the prototype quickly. These steps will not take a long time because

it is only a small aspect will be considered. After that, this prototype will be implemented to see the effectiveness.

For this procedure, the involvement from the users is important for giving the retaliation to the units of prototype, which has been developed. The system developer will focus to the matter, which is suggested by the users for making the changes. The changes will include the prototype's design step and the following steps until the users are totally satisfied with the system.

Steps of prototyping:

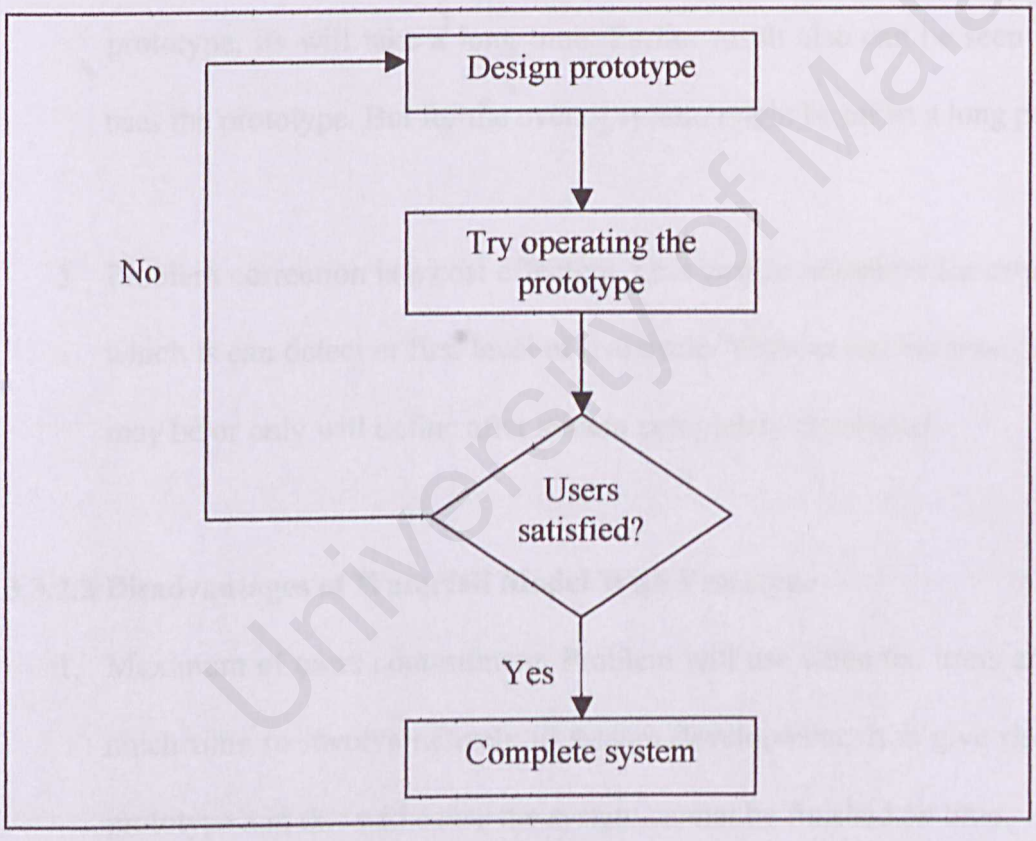

Figure 3.2: Implementation of Prototype

3.3.2.1 Advantages of Waterfall Model With Prototype

1. Allow users give their commitment to produce a useful input during development system process. One of the main objective in prototyping is to design system that is fulfilled the users need. According to this method, the users focus on the system design and the components that develop the system. During observation, the users will give their feedback to the system as their needs. Hence, the objectives of system development are easier to achieve.

2. System development just takes a short time to develop it. To develop a simple prototype, its will take a long time. Earlier result also can be seen quickly with uses the prototype. But for the overall system might be taken a long period.

3. Problem correction is a cost effective. Less cost requirement for error correction, which is can detect at first level of live cycle. Without use the prototype, problem may be or only will define after system completely developed.

3.3.2.2 Disadvantages of Waterfall Model With Prototype

1. Maximum of users commitment. Problem will use when the users are not having much time to involve actively in system development. It is give rise to steps of prototype and this will cause the system cannot be finished on time.

2. Activities that produce prototype might bring the system development to non-meditate scope and are not expected. Users always needs the good system and

feedback receive may be out of development's objectives. From system scope and produce a bigger system. It might be the system not effective cannot be finished and will damage. However, a good management during phase level in the system can avoid this problem.

Entirely, waterfall model with prototype laid emphasis on users satisfied and the interactive techniques that assume appropriate to the Digital Clinic System. This model is more emphasis on user's requirement factors and also indirect support humanity aspect system development. For example, interface design. System development should determine so that the interface design can be accepted and understand the users to get the interface.

3.4 Focus detail on each Waterfall Model with Prototype Phases

3.4.1 Software Engineering

Definition:

"Software Engineering is the application of scientific principles to the orderly transformation of a problem into a working software solution and the subsequent maintenance of that software until the end of its useful life. Software Engineering is more than just programming. The software engineering process generally starts long before a line of code is written and continues long after the initial version of the program has been completed. People and projects were following the process the approach software development." (SOMMERVILLE, I., 2000).

For the first phase of the thesis, the first step, which is requirement analysis and definition, will be done. It consume quite a portion of the system development time to ensure that the system will be design under a well plan and follow a exact scope.

The software development steps sometimes also called the Software Development Life Cycle (SDLC). The principle stages of the model map onto the fundamental development activities.

3.4.1.1 Analysis and Requirement Definition

The system services, constrains and goal are established by consultation with system users. Both users and developer then define them in a manner that is understandable.

This stage may begin with some analytic work, to determine the information requirement, what system objective have been identifies and focus on the users requirement for the new system. The stage may include a feasibility study to determine the possible alternatives for proceeding further. The stage may also focus on the existing system, their scope and whether they are for phase out or are adaptable for future use.

3.4.1.2 System and Software Design

The system design process partition the requirement to either hardware or software system. It establishes an overall system architecture. Software design involves

representing the software system function that may be transformed into one or more executable programs.

A system design stage typically includes the preparation of components of different kinds. It is possible to prepare components of the system design stage in such a way that are independent of a specific tool that will be used to develop the system. By definition, it involves knowledge of the tools to be used to develop system.

3.4.1.3 Implementation and Unit Testing

During this stage, the software design is realized as a set of programs or program units. Unit testing involves verifying that each unit meets its specification.

3.4.1.4 Integration and System Testing

The individual program units or programs are integrated and tested as a complete system to ensure that the software requirements have been fulfill. After testing, the software system is delivered to users.

Before the system can be used, it must be tested. It is much less costly to catch problems before the system is signed over to users. A series of tests to pinpoint problems is first run the system with sample data and eventually with actual data from the current system.

3.4.1.5 Operational and Maintenance

Normally this is the longest life cycle phase. The system is installed and put into practical use. Maintenance involves correcting errors that were hot discovered in the earlier stages of the life cycle; improving the implementation of the system units and enhancing the system services as new requirement are discovered.

Maintenance of the system and its documentation begins in this phase and is carried out routinely throughout the life of the system. Much of the programmer routine work consists of maintenance and spends a great deal of money on maintenance.

3.5 Information Gathering

Information gathering is the most important step in defining scope and objective of the system. It provides a better understanding and better view to the requirement of the system. The methods that are used to collect facts are:

- Material reading/Internet research
- Interview
- Observation
- Study on system that exists

3.5.1 Material Reading/Internet research

The main source of collecting the related literature was thru reading medical references from the Internet surfing. Some relevant information was being search on the Internet, especially that technical information in developing the system.

3.5.2 Interview

Interview process has been carried out in order to identify and understand the loopholes and weaknesses of the current clinic management system. Interview sessions are done together with future users, which comprise of the patients and clinic staffs.

3.5.3 Observation

Observing the decision-making and the decision maker's physical environment are important information gathering techniques for system analysts. Observing the clinic environment and the activities that happened in clinic help retrieving important information, which has not been mention during the interview. A clearer picture on the flow of the transaction and the management system of the clinic had been captured.

3.5.4 Study on System that exists

A study has been made on the system that exists. It provides a clearer picture of how a clinic system operates and how the system was build. The result and summary of the study are shown in chapter 2.

3.6 Summary

Therefore, I believe that development approach consisting on the Waterfall Model with prototype is the most appropriate methodology. It will serve as the main guidance towards the development of the Digital Clinic system.

Chapter 4: System Analysis

4.1 Introduction

As I mention before, system analysis and analysis requirement phases are the earliest phases in the system development life cycle. These phases are important to obtain clarification and knowing about important aspects that necessary be considered in develops a system.

System analysis activities necessary approach that elaborately states the point of user and administrator side and also few of specification requirements that determined by the organization.

This analysis important to make sure the system performs and supports requirement and user needed. For this purpose, analysis system is divided into 3 main separated that are user analysis, administrator analysis and specification requirement system that include functional requirement and non-functional requirement.

4.2 User Analysis

For this purpose, user system is divided into 2 sections that are user and administrator system (including the doctor). This separated are executed to obtain clearer and more detail perspective from different user side.

As that mentioned, I was prepared the investigation form and distributed to 20 respondents that consists of people in many level and age. The respondents were

involving clinic staffs and public. This is important to get feedback and opinion clearly about Digital Clinic System.

4.2.1 Analysis and Synthesis from Investigation Form

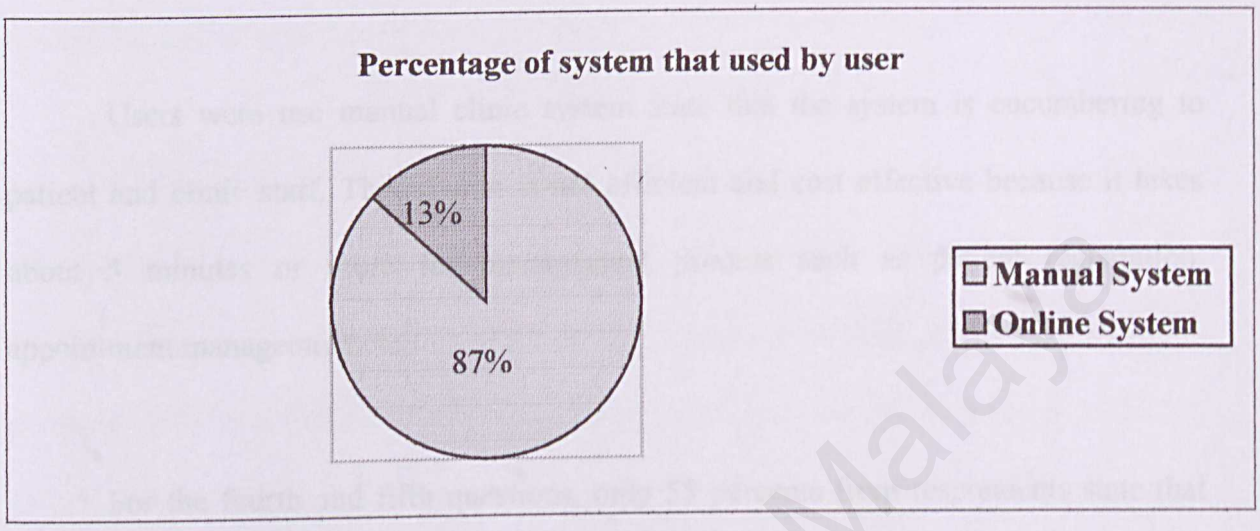

Figure 4.1: Pie chart shown percentage of how users register for clinic system

The questions that be asked to the respondents are:

1) How do you register to the clinic system?
2) How long do you spent to register or use this system?
3) How do make an appointment with the doctor?
4) In your opinion, does the system that you use encumber to patient and staff?
5) Do you satisfy with the system that you are using?
6) Do you agree if any online clinic system is developed?

For first question, most of user generally (from 20 respondents) never uses online system. Study from the investigation that is done and knowable that 87 percents from respondents use manual clinic system. And the rest of them, ever or have been use online clinic system (13 percents).

Users were use manual clinic system state that the system is encumbering to patient and clinic staff. This system is not efficient and cost effective because it takes about 5 minutes or more for management process such as patient registration, appointment management etc.

For the fourth and fifth questions, only 55 percents from respondents state that system they used are not satisfied. 35 percents are not so satisfy as the other and other 10 percents are satisfied with the manual clinic system they are used. And for the respondents that ever use online clinic system is satisfied with the system and they state the system necessary enhancement.

For final question, most of the respondents were agree with suggestion to develop Digital Clinic System. 67 percents of the respondents were agreed and other 33 percents were not agreed. The respondents that agreed with the suggestion are state that is a good idea to save time and cost effective. For the respondents was not agreed state that they are not familiar with computerized system.

4.3 Analysis Administrator

Conclusion that I can make from the interview sessions is most of the respondents enthusiastic with the suggestion to develop system that implement with online system (98 percents). I was interviewing some of the clinic staff around Muar, Johor. They are Mrs. Sawiah Kassim and Dr. Mohd Tasnain Sabri.

Besides they storied about background and usage system that exists, they also believe that is so practical if a clinic management system is performed as online system. Beside to less the peripheral cost, this technique also can spend more time and energy to perform this system. And also with updated view data information, that easier to access, just download from website and not necessary procedure and process that only waste time. For analysis administrator, simple approach is used through the interview. A few questions are ready that will be asked to clinic staff for develop this system. The questions are:

1. How and what technique that be used to keep important information and personal patient information in this system?
2. Does has any security aspect that is given to important information and patient information that be registered?
3. How doctor schedule his/she timetable between task and appointment with patient?
4. Does has any problem during use current system? What is the problem?
5. Do you agree if any system that implement with online system?

4.4 Specification Requirement System

This section covers the aspect of functional requirements and non-functional requirement of Digital Clinic System. Digital Clinic System is divided into three separate modules, mainly administrator module, doctor module and patient module. The functional requirement will be described as follows:

4.4.1 Functional Requirement

4.4.1.1 Patient Module

The patient will be the front end user of the system. They shall be given access to the patient information, patient appointment and patient diagnosis. However, they are restricted from editing and deleting the data in the system except their personal particulars such as their telephone number, email address etc. there few functions that will work in order to facilitate the patient module. They are:

1) **Sign up module**

Allows new patient register to the clinic as online. This module will be viewed automatically when patient want register to the clinic system. This module gives view based on interactive form, where is needs the patient entering the patient information. This system gives chance to patient to choose his or her own password in log in user process. System just allows patient to choose the password not less than 6 characteristic. With just click the submit button, registration information will be kept into database.

2) **Registration record module**

Registration record will be viewed to the patient for double check the patient information. Error message will be sent to patient if the form is not complete.

3) **Sign in module**

Patient needs to enter their user name and password that has been registered during registration process. System able to find out password that have been entered either it is true or false. Patient is allowed to change his or her username and password.

4) **Appointment module**

This module allows patient to make an appointment with a doctor based on doctor's schedule. This system provides a form that can be filled by patient to make an appointment with the doctor.

5) **Diagnosis Module**

This module allows patient to make diagnosis for unserious problems and get the appropriate prescriptions based on the intelligent module that is available in this system.

6) **Sign out module**

This module allows patient to quit from system with click the log out button. System able to inform patient that sign up process is successful.

4.4.1.2 Doctor Module

1) **Sign in Module**

This module view the doctor page where is necessary doctor to log in his/her user name and password first. This module allows doctor to add, delete, and modify his/her records systematically.

2) **Appointment Management Module**

This module also can view appointment message automatically when he/she login to doctor page. Appointments are effectively scheduled with the ability to increase patient convenience through a suitable choice of pre-appointment reminder. At any point of time, the doctor can rearrange their schedule; the appointment management will be automatically updated.

3) **Schedule Task Module**

Allows doctor to schedule and plan his/her daily works and add, delete, modify his/her record systematically.

4.4.1.3 Administrator Module

This section allows the admin to manipulate the records in the database. This includes the right to create, delete and update the data in the database. The admin also has the right to view the result of the appointment, change the password and searching for the user data.

1) **Sign in module**

This module view page for administrator that is responsibility to system maintains. System can view form that is used to enter administrator name and his/her password for determined either he/she is a clinic staff. This information will be processed and compared with information that has been in database. For database, information that is relevance to administrator ID will be kept in relevance file.

2) **System Management Module**

System Management module provides the administrator of the Digital Clinic System complete control over the users of the system

- **User Management**

This sub-module caters for the management of personnel authorized to access the system.

– *Add User Profile*

The system administrator can add a new account for an authorized user, set password and fill in the full personal information.

- *Edit User Profile*

  The system administrator can edit the user details; change the password and lock/unlock the account.

- *Delete User Profile*

  When user account is no longer in use, the details can be removed from the system.

3) Appointment Module

This section allows the administrator to check appointment status that has been made by patients. This module also can view patient appointment details to confirm the appointment.

4.4.2 Non-Functional Requirement

The non-functional requirements define the system properties and constraints. These requirements are very subjective and play an important role in the system functional ability:

1. Usability and user friendliness

The Digital Clinic System will be developing base on the GUI. Thus, it will provide a better visualization to user and reduce the risk where user make mistake when using the system. Icon with understandable meaning will be used.

2. **Consistency**

Standard icon will be used throughout the whole system so that user won't mixed up the function and feel confident performing their daily task. Apart from this, the user interface will have a consistent color and organized layout for the whole system even though in different sub module.

3. **Reliability**

Managing patient data is a critical task and sometimes involving human life. Thus the system will have to be developing so that it is reliable and can recovery in short period when facing system failure. Backing up database information will have to be done in certain period to avoid any unpredictable disaster.

4. **Efficiency**

This system should provide an efficient data storage and retrieval. The new user should be able to be familiar with the system in short time. This system also enables users to handle their jobs efficiently by reducing time, manpower and other resource.

5. **Integrity**

This system allows only authorized user to access the system. The valid users have to log on the system by using their user password. This will ensure the integrity of data and system.

6. **Security**

The security feature enables the system to meet the security requirements for storage, communication and displaying of data. Patient records are one of the highly secure data and need to be protecting against viewing by unauthorized personal. The security management module will have a big responsibility to ensure the security of the system.

4.5 Analysis and Synthesis of Development Tools

4.5.1 Analysis and Synthesis of Web Server

After study the advantages and disadvantages of web server, Internet Information Server is chosen as web server for this system. This is because Internet information Server is integrated with Windows 2000 that I choose for operating system.

4.5.2 Analysis and Synthesis of Operating System

Windows 2000 is chosen where it is be easier to use and to manage, because Microsoft Windows 2000 Professional is more compatible and more powerful than any workstation used before.

- **Easy to use**

With Windows 2000 Professional, faster access to information, and able to accomplish tasks more quickly and easily.

Windows 2000 Professional makes it easier to:

- Work with files.
- Find information.
- Personalize your computing environment.
- Work on the Web.
- Work remotely.

- **Easier to manage**

Network administrators can work more efficiently, because many of the most common computer-management tasks are automated and streamlined with Windows 2000 Professional.

With Windows 2000, your workstation will be easier to:

- Set up.
- Administer.
- Support.

- **More Compatible**

Windows 2000 Professional offers increased compatibility with different types of networks and with a wide array of legacy hardware and software.

Windows 2000 also provides:

- Improved driver support.
- Increased support for new-generation hardware and multimedia technologies.
- Integration of the new Euro currency symbol.

- **More Powerful**

For all your computing needs, Windows 2000 Professional provides:

- Industrial-strength reliability.
- The highest level of security.
- Powerful performance.

4.5.3 Analysis and Synthesis of Database

For Digital Clinic System development purpose, database implication is quite large and able to be connected to user server environment. There for, Microsoft Access 2000 is chosen as database development software. At the side of it does not need additional software because it is already have in Microsoft office 2000 package, it is also can integrate with Macromedia Dreamweaver Ultradev.

Microsoft Access provides new features designed to help easily use the Internet. What I need is a Web browser, such as Microsoft Internet Explorer, and a modem, intranet connection, or other network connection to access the Internet and take advantage of some of these new features.

- **Create data access pages** Create Web pages that can use to add, edit, view, or manipulate current data in a Microsoft Access database

- **Collaborate over an intranet or the Internet** Use NetMeeting to collaborate with others on a Microsoft Access database or Microsoft Access project.

- **Assign a hyperlink to a toolbar button or menu command** Assign a hyperlink to a toolbar button or menu command for easy access to a location on my computer, a network, an intranet, or the Internet.

4.5.4 Analysis and Synthesis of Technology and Script Language

Asp provides easy method to access information. Asp can be act as a medium between database and interface to produce dynamic information to user. It also fulfill user request with more efficient and effective beside easier developed compare to CGI.

VBScript and JavaScript are appropriate script language in web development technology. But there are different in ability to interface at browser aspect. JavaScript interface is much better uses Netscape Navigator and VBScript is appropriate to use Internet Explorer. Beside, JavaScript is object oriented and VBScript is subset to Visual Basic.

As a result, for this system development, web development technologies that are chosen are ASP and VBScript because both of them are able to produce system with minimum complexity.

4.5.5 Analysis and Synthesis of Web Editor

Macromedia Dreamweaver Ultradev has been selected as web editor for development system. It is provide easy web development facilities and up to date, support

ASP to produce dynamic website, support ODBC for system connection technique to database and support other file format such as gif, flash and jpeg.

4.6 Hardware and Software Requirement

After study and comparison hardware and software requirement in chapter 2, here is the analysis and synthesis of hardware and software requirement that have been chosen:

4.6.1 Hardware Requirement

- Personal Computer, with Intel Celeron processor 333MHz or higher.
- 64MB of RAM
- 3GB of hard disk space or higher
- 15" Digital Monitor
- Keyboard, mouse as input devices.

4.6.2 Software Requirement

- Internet Explorer for the user interface.
- Active Server Page (ASP) as web scripting.
- Microsoft Internet Information Server (IIS) as a web server
- Macromedia Dreamweaver Ultradev 4.0
- Windows 95, Windows 98, Windows 2000 or Windows NT Operating System.

Chapter 5: System Design

5.1 Introduction

System design is concerned with how the system functionality will be provided by the different components of the system. System design is stages in the development process where the requirement for the system are translate into the system characteristics. There are 4 major components in the system design:

- Architecture Design
- Database Design
- User Interface Design

5.1.1 Architecture Design

5.1.1.1 Management Information System (MIS)

Definition:

Management Information System (MIS) is computerized information system that work because of the purposeful interaction between people and computers. By requiring people, software (Computer Program), and hardware (computer, printer etc) to function in concert, management information system supports a broader spectrum of organizational tasks than transaction processing systems, including decision analysis and decision-making.

A Digital Clinic System can be defined as an open system, which attempt to integrate and communicate the outside and inside flow of information within a clinic. It

also provides the common functions for all application. The areas include, medical information system, patient administration system.

5.1.1.2 Client Server Architecture

Definition:

An organization of computers on a network in which one computer (the client) is requesting a process or data from another computer (the server) attached to the network. *[*SULLIVAN, *J.]*

The team is a functional, not a physical description. In other words, the two computers may alternate their roles as "client" and "server". Binding is the process whereby the association between the client and server occurs. Binding may be dynamic which means that the client finds the appropriate server through the network directory service if the server is registered. Binding may be provided directly if the client knows the IP address.

In a network, the client/server model provides a convenient way to interconnect programs that are distributed efficiently across different locations. In the usual client/server model, one server, sometimes called a daemon, is activated and awaits client requests. Typically, multiple client programs share the services of a common server program. Both client programs and server programs are often part of a larger program or application. [KALAKOTA, R.]

Using a relational database management system (DBMS), user queries could be answered directly. The client/server architecture reduces network traffic by providing a query response rather than total file transfer. It improves multi-user updating through a GUI front end to a shared database. In client/server architecture, Remote Procedure Calls (RPCs) or Standard Query Language (SQL) statement are typically used to communicate between the client and server. [TAYLOR, L.]

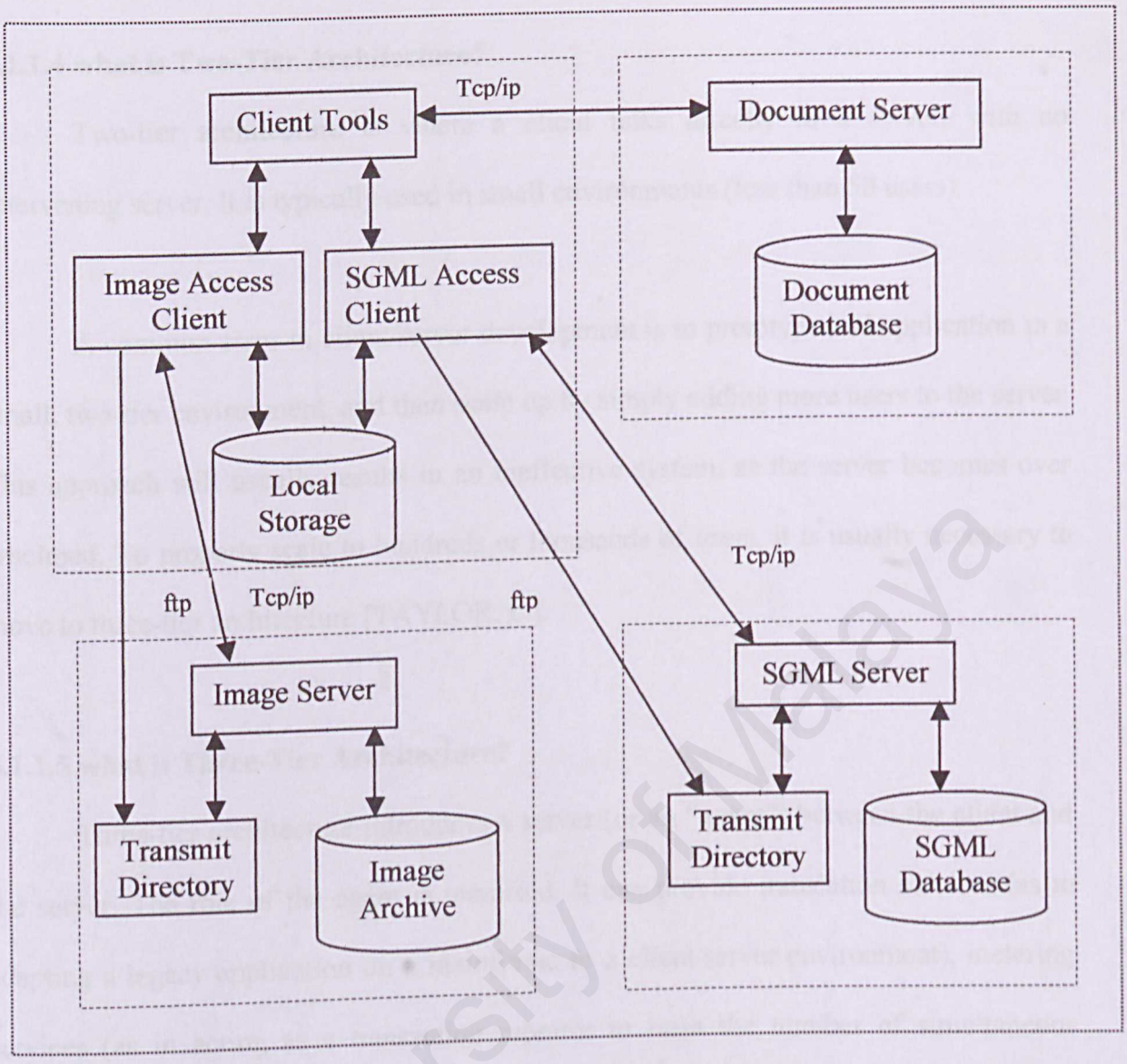

Figure 5.1: The distributed client-server application

5.1.1.3 Digital Clinic System Using Three-Tier Architecture

In the recent year, client/server system has revolved to two-tier, three-tier and n-tier architectures. The following are some information regarding the two-tier and three-tier architecture and the reason why three-tier had been chosen in the system.

5.1.1.4 what is Two-Tier Architecture?

Two-tier architecture is where a client talks directly to a server, with no intervening server. It is typically used in small environments (less than 50 users).

A common error in client/server development is to prototype and application in a small, two-tier environment, and then scale up by simply adding more users to the server. This approach will usually results in an ineffective system, as the server becomes over whelmed. To properly scale to hundreds or thousands of users, it is usually necessary to move to three-tier architecture [TAYLOR, L.].

5.1.1.5 what is Three-Tier Architecture?

Three-tier architecture introduces a server (or an "agent") between the client and the server. The role of the agent is manifold. It can provide translation services (as in adapting a legacy application on a mainframe to a client/server environment), metering services (as in acting as a transaction monitor to limit the number of simultaneous requests to a given server) or intelligent agent services (as in mapping a request to a number of different servers, collating the results, and returning a single response to the client. [TAYLOR, L.]

It consists of three well-defined and separate processes, each running on a different platform [SADOSKI, D.]:

1. The user interface, which runs on the user's computer (the client).
2. The functional modules that actually process data. This middle tier runs on a server and is often called the application server.
3. A database management system (DBMS) that stores the data required by the middle tier. This tier runs on a second server called the database server.

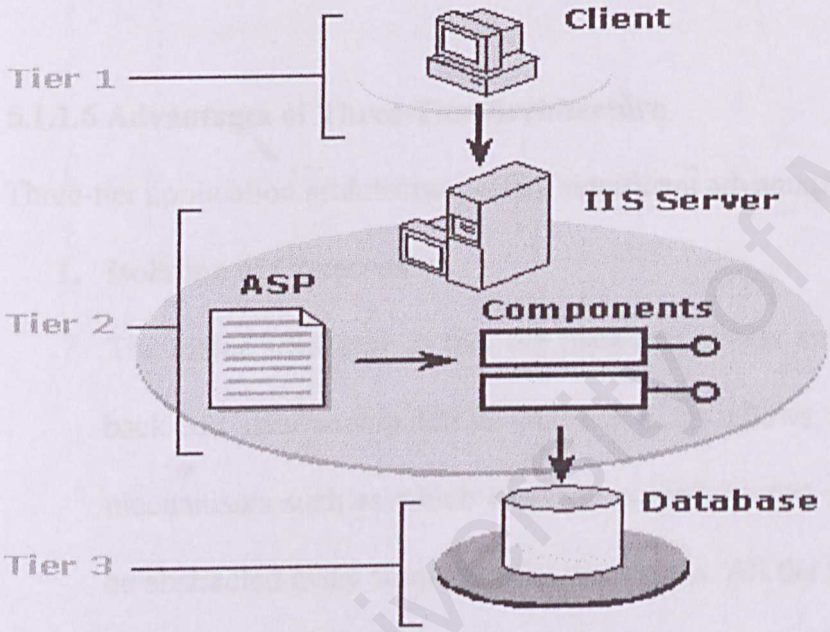

Figure 5.2: Three-Tier Architecture

The three-tier design had the advantage over traditional two-tier design or single-tier because of the following reason [SADOSKI, D.]:

- The added modularity makes it easier to modify or replace one tier without affecting the other tiers.
- Separating the application functions from the database functions makes it easier to implement load balancing.
- The ability to support transaction by a huge number of users on the server at the same time.

5.1.1.6 Advantages of Three-Tier Architecture

Three-tier application architecture offers significant advantages in the following criteria:

1. **Isolation of Concerns**

   The major advantage is that the front-end clients are clearly separated from the back-end data manipulation facilities. This allows details of the data storage mechanisms such as which database is used, record structure and field names to be abstracted away from the client processes. All the front-end sees is an abstract operation request which takes input and output parameters.

2. **Enabling Database Migration**

   Database restructuring, upgrades, migration or other changes can be performed without the necessity to stop or alter the client programs.

3. **Front-End Modifications**

   Similarly, new front-end clients can be introduced or old ones removed without any need to modify the databases or provide new access mechanisms.

4. **Data from Multiple Sources**

   A client may require data from a number of servers. This can be handled easily because a Control Agent automatically splits the data operation request into several sub-operations. The appropriate agent then performs each sub-operation and the combined results forwarded to the calling client.

5. **Reduced Database Loading**

   In Three-Tier Architecture, not only does the database machine benefit from fewer connections but also any data caching operations results in fewer data operations and therefore fewer throughputs. In addition, this saving is concentrated on those very queries that are most commonly performed, thus reducing the potential for conflict on any hot spots in the data.

As a conclusion it was found that the three-tier architecture is:

- Reliable
- Scalability
- Easy to control
- Flexible to change

5.1.2 Database Design

This phase involve process are relevance with database design that will be used to store information's that relevance with registration along system execution. This database will used to record all input or output data process that happen when user use this system.

For yield database that able to accommodate all information process in this system, database design must be planned. This is to avoid data lost or data overlap that might be happen when there is dearth on database structure.

For this purpose, understanding this system is important to make sure the entities in this system and understand the connection is exist between entities. For develop database in this system, some entities are determined. All this entity will ensure fluency of system process. Entities that will determined are discussed as below:

Table 5.1: Database Design for Digital Clinic System

Table	Field Name	Data Type	Field Size
StaffAccount	• Staff_ID (Primary key)	Text	50
	• Staff_Name	Text	50
	• Staff_Password	Text	50
	• Address	Text	255
	• Telephone_No	Int	50
	• Email	Text	50
DoctorAccount	• Doctor_ID (Primary key)	Text	50

	• Doctor_Name	Text	50
	• Doctor_Password	Text	50
	• Address	Text	255
	• Telephone_No	Int	50
	• Email	Text	50
Appointment	• Patient_ID	Text	50
	• Appointment_ID	Text	50
	• Time_Slot	Text	50
	• Date_Booked	Text	50
	• Doctor_ID	Text	50
	• Doctor_Name	Text	50
Staff_ID (Authorized staff)	• Username (Primary Key)	Text	50
	• Password (Primary Key)	Text	50
PatientAccount	• Patient_id (Primary Key)	Text	50
	• Patient_Password	Text	50
	• Patient_Name	Text	50
	• Address	Text	255
	• Telephone_no	Text	50
	• Email	Text	50

5.1.3 User Interface Design

This phase involve planning process to produce sketch process that occurred in system, beside important to design appropriate user interface and fulfill user requirement.

Each relevance process that planned and sketched into diagram uses ER-Diagram and Data Flow diagram (DFD) methods. ER-Diagram is used to facilitate database design. The main purpose for developing entity-relationship model is to support a user's perception of data, and to conceal the more technical aspects associated with database design.

Then DFD that is produced can be used to increase the entirely imagine about system. Its not also describe work flow of process system but it also can imagines work flow for input in or out that will be processed before produce its output.

The following steps are to design the sketch of user interface that will be produced. It must be obey user-friendly concept, purposefully to help facilitate user uses this system. For this purpose, usage of Macromedia Dreamweaver Ultradev software will be used. It is also yield programming that can designs forms where will be used in this system. These forms will be used to receive data by user entered before it will be processed and stored in database are provided.

It will uses facilitates are provided in this software such as text box, check box, radio button etc. All this facilitate can help the user to enter the data are relevance with registration request easily.

User interface design involve diagram that is guidance entire system to carry out each process is involved. Here, these are ER-Diagram is shown in figure 5.3 and Data Flow Diagram will shown in figure 5.4 for Digital Clinic System.

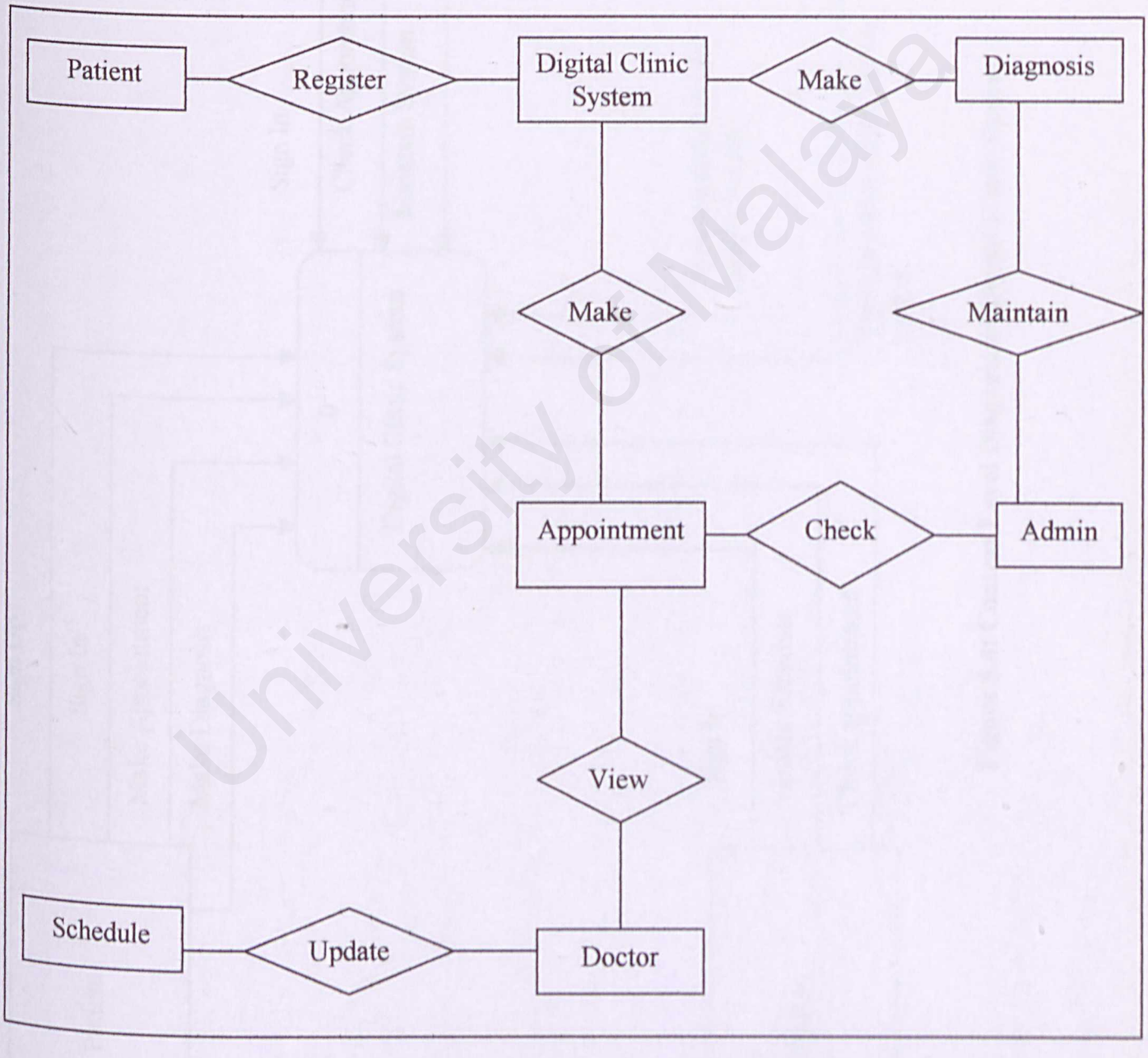

Figure 5.3: Entity-Relationship Model of Digital Clinic System

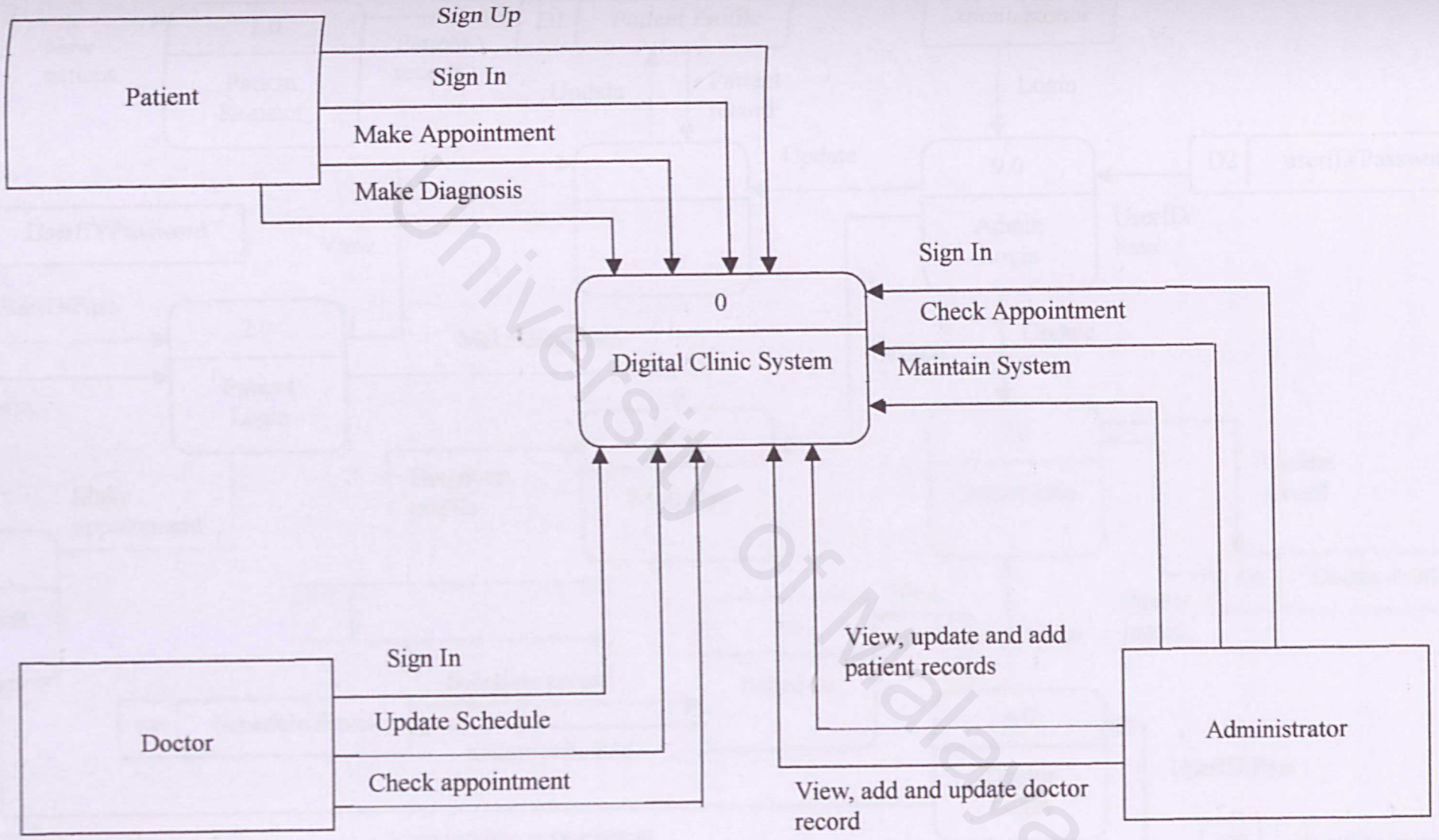

Figure 5.4: Context Level Diagram of Digital Clinic System

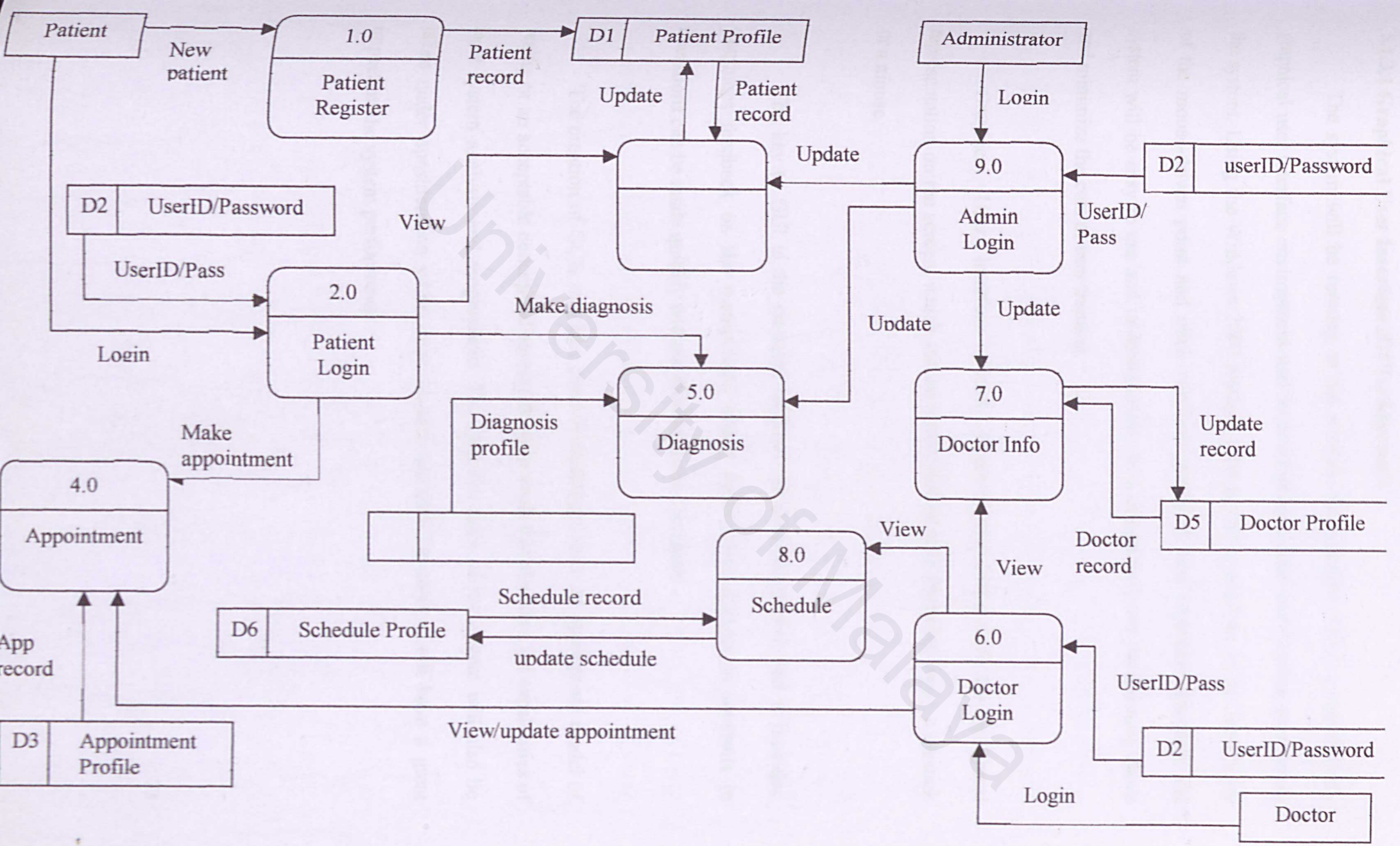

Figure 5.5: Level Zero Diagram of Digital Clinic System

5.1.3.1 Graphical User Interface (GUIs) Approach

The system will be running in the window environment. Thus, a user-friendly graphical user interface environment will be developing to ease users burden when using the system. Using the Windows 2000 platform, the system capitalizes on the familiarity of the mouse-driven point and click windows graphical user interface approach; the system will be easy to use and understandable. It is design to lower the learning curve and minimize the cost of user training

Graphical User interface allows direct manipulation of the graphical representation on the screen, which can be accomplished with keyboard input, a joystick or a mouse.

The key to GUI is the constant feedback on task accomplish that it provides. Continues feedback on the manipulated object means that changes or reversals in operations can be made quickly without incurring error message.

The creation of GUIs interface poses a challenge, since an appropriate model of reality or an acceptable conceptual several skills in away that stretches the capabilities of most system analysts and programmer. The response time of the system will also be taken under consideration while creating user interface because it will have a great impact on the system performance.

Chapter 6: System Implementation

System implementation is a process that converts the system requirements and design into program codes. It involves the translation of the software representation produced by the design phase into a computer-readable form. Nearly all the design phases that have been presented to this point are directed towards a final objective: to translate representation of software into a form that can be "understood" by the computer. I have (finally) reached the coding step a process that transforms design into a programming language. The primary goal of this phase is the production of a simple, clear source code with internal documentation that will ease the processes of verification, debugging, testing, modification and further enhancement. Besides that, this phase also going to discuss about the coding methods used during the development of Digital Clinic System.

6.1 Development Environment

Development environment has certain impact on the development of a system. It is crucial for the rapid development of Digital Clinic System. Using the suitable hardware and software will speed up the system and it performance. The hardware and software tools used to develop the entire system are as follow:

6.1.1 Hardware Requirements

- Personal Computer, with Intel Celeron processor 333MHz or higher.
- 64MB of RAM
- 3GB of hard disk space or higher
- 15" Digital Monitor

- Keyboard, mouse as input devices

6.1.2 Software Tools Requirements

- Internet Explorer for the user interface.
- Active Server Page (ASP) as web scripting.
- Microsoft Internet Information Server (IIS) as a web server
- Macromedia Dreamweaver Ultradev 4.0
- Windows 95, Windows 98, Windows 2000 or Windows NT Operating System

6.1.2.1 Software Tools for System Development and Design

The software tools used for system development are vital to successful implementation of this system. The table below lists all the software used to develop Digital Clinic System.

Table 6.1: Software Tools for Development

Software	Module	Description
Microsoft Windows 2000	System Requirement	Operating System
Microsoft Access 2000	System Requirement	Database Server
Macromedia Dreamweaver Ultradev 4.0	System Development	Web Page Coding
Internet Explorer 6.0	System Development	Web Page Browsing

6.1.2.2 Software Tools for Report Writing

Microsoft Word 2000 is used to write the report because of its wide availability and user friendliness.

6.2 Program Development

Program development is the process of creating the programs needed to satisfy an information system's processing requirements. Program development consists of the following five steps: review the program documentation, design the program, code the program, and test the program and completion the program documentation. (Figure 6.1)

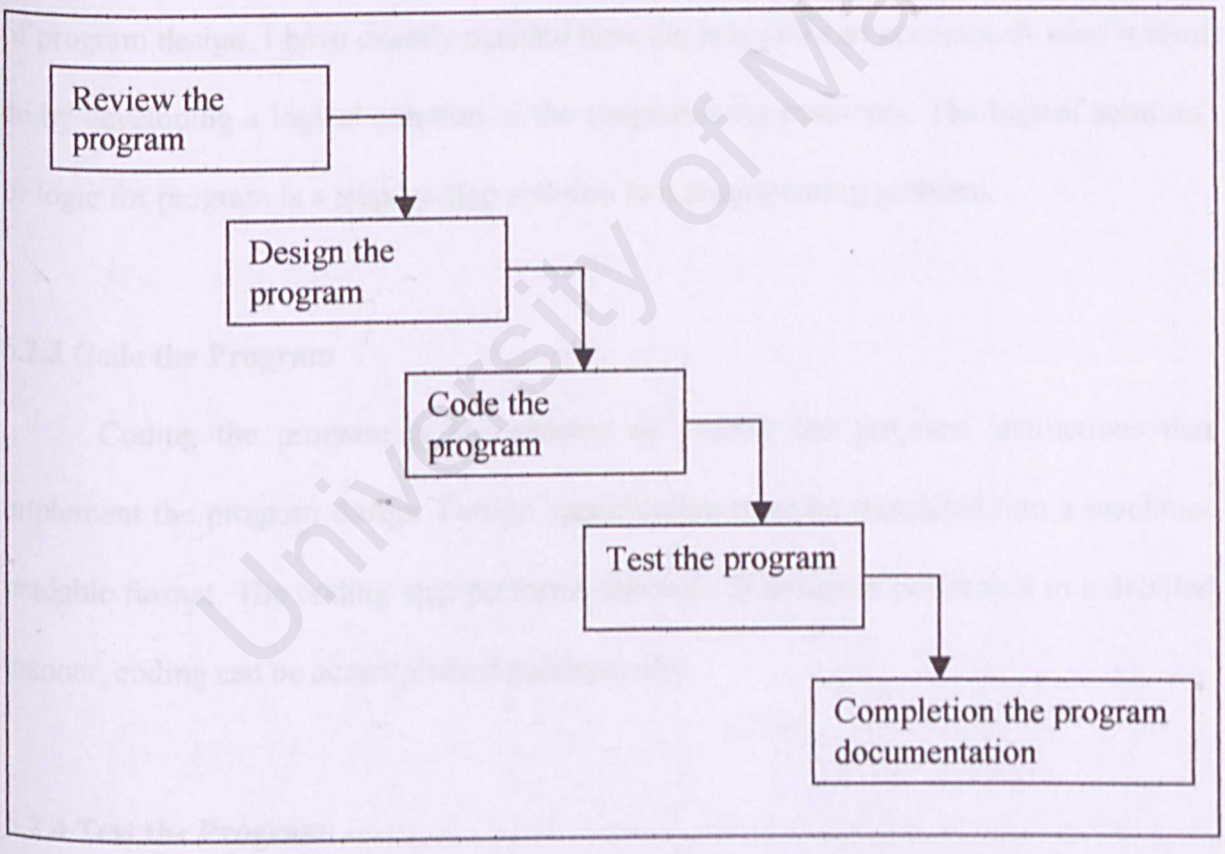

Figure 6.1: The five steps of program development

6.2.1 Review the Program Documentation

The first step in the program development is to review the program documentation that was prepared during the previous phases. The program documentation of catalogue ordering system consists of simple process descriptions, report layouts, data dictionary entries and the source documents. This documentation helps me to understand better the work that needs to be covered during this coding phase.

6.2.2 Design the Program

After the program documentation review, I need to design the program, which is the second level of program design during the system development. For this second level of program design, I have exactly decided how the program can accomplish what it must do by developing a logical solution to the programming problems. The logical solution, or logic for program is a step-by-step solution to a programming problem.

6.2.3 Code the Program

Coding the program is the process of writing the program instructions that implement the program design. Design specification must be translated into a machine-readable format. The coding step performs this task. If design is performed in a detailed manner, coding can be accomplished mechanically.

6.2.4 Test the Program

During the testing program level, I must thoroughly test a program to ensure it functions correctly before the program processes actual data and produces information on

which people will rely. I will perform several types of test on an individual program. (Will be further discusses in details in section below).

6.2.5 Document the Program

Accurate and complete program documentation is essential for the successful operations and maintenance of the information system. This documentation includes the system user manual that may need by most of the customers as well as the system administrators.

6.3 Program Coding

As we know in system implementation, the program coding is a process that translates a detail design representation of a system into programming language.

Macromedia Dreamweaver Ultradev is used for writing the program. The algorithm is transferred to lines of code. Active Server Pages (ASP) is practiced in most of the programming in coding. Within the ASP, client side scripting languages such as VBScript and JavaScript was used occasionally. Besides that, transact Microsoft Access is used when writing stored procedure.

The coding basically can be divided into tree parts and these are user part, doctor part and administrator part.

6.3.1 Methodology

Digital Clinic System using a modular approach where each module is developed separately and are later integrated into a fully functional system. For each module, it is further refined into functions and procedures. By using a modular approach, future modification and enhancements are made easily.

6.3.2 Coding principles

The following principles were applied during the implementation of Digital Clinic System:

- **Coding Conventions**

  Coding conventions such as program labeling, naming conventions, comments and indention should be adhered to. It provides easy identification for the programmer.

- **Readability**

  Codes should be easy to understand. Adherence to coding conventions such as naming conventions and indentation contribute to program readability.

- **Maintainability**

  Codes should be easily revised or corrected. To facilitate maintenance, code should be readable, modular and as general as possible.

- **Robustness**

  The codes should be able to handle cases of user error by responding appropriately.

- **Internal Documentation**

  Internal comments provide a clear guide during the maintenance phase of the system. Comments provide the developer with a means of communicating with other readers of the source code. Statements of purpose indicating the function of the module and a descriptive comment that is embedded within the body of the source code is needed to describe processing functions.

6.3.3 Major Functions of Digital Clinic System

- **Data Verification**

  Before a record can be stored in database, this function will check either the record that was entered by user is valid or not. If the record is not valid, the user is needed to reenter the correct data. This function is important to make sure the reliability of data.

- **Data Search**

  Authorized users who want to make a diagnosis online, they may to do so by using the search engine that is provided by this system. They just need to key in the keyword to fine the desired record. Message will be shown if the record was not found and if record found, it will be displayed.

- **Update Data**

  This function contain of programming codes for updating record process that were exist in database. Update record is available to administrator only.

- **Delete Record**

  This function contain of programming codes that used to delete record. Only administrator can delete record. Example, administrator deletes user record or appointment record.

- **Add Record**

  This function is used to add record or information. Administrator provides it. Example, add an URL for diagnosis online or add an appointment to set user appointment with a doctor.

- **User Interface**

  To build a user-friendly system, a complex programming code is not needed. Digital Clinic System user tools are provided with buttons or hyperlinks at each page to ease of use by user.

6.3.4 Web Page Development

Being a fully web-based online registration system, Digital Clinic System makes use of the Internet browser. It has been coded by using the Hyper Text Markup Language (HTML).

As for server scripting, ASP technology and VBScript are used. ASP eases database retrieval and manipulation. The web server process ASP files before being presented to the browser. The user will not be able to view the code written in ASP codes. This is because the web server will interpret all ASP codes into HTML codes, whenever user requests the ASP files.

In addition, Macromedia Dreamweaver Ultradev 4.0 is used to develop the web pages and debugging the errors. It provides rapid development environment for building ASP, extensive database tools for connecting a web site to any database via Open Database Connectivity (ODBC) and a multitude of wizards to create simple database driven web application.

6.3.5 Database Connectivity

In order to connect the user section to the database, Open Database Connectivity (ODBC) was created in the server by specifying the Data Source Name (DSN). However, the administration section used ActiveX Data Objects (ADO) to connect to the database. ADO provides the means by which program code accesses a database. ADO connects to a database through an OLE DB provider. OLE DB is Microsoft's new lower-level

database interface that provides access to many different kinds of data. The OLE DB provider exposes this database to ADO, which in turn allow connection to data using Data Controls or Object interface. OLE DB was used as it can access to other files such as word document, spreadsheet, and mail and so on besides database files. This makes the application more flexible.

Chapter 7: System Testing

Testing is the process of exercising of evaluating a system by manual or automatic means to verify that it satisfied requirements of to identify differences expected and actual results. By the other words, testing is a verification and validation process.

Verification refers to set of activities that ensure that the software correctly implements a specific function. On the other hand, validation refers to a different set of activities that ensuring the software have been built traceable to user requirements. Software testing is a critical element of software quality assurance and represents the ultimate review of requirements specification, design and coding.

Rules that can serve well as testing objectives are:

- Testing is a process of executing a program with the intent of finding an error.
- A good test case is one that has a high probability of finding an undiscovered error.
- A successful test is one that uncovers an as yet undiscovered error.

According to C. Kaner, J. Falk, H. Q. Nguyen (1993), a good test must including the following features:

- A good test has a high probability of finding an error.
- A good test is not redundant.
- A good test should be "best of breed".

Thus, testing is only successful when a fault is discovered or failure occurs as a result of testing procedures.

The system has undergone three stages of testing. They are unit testing, integrating testing and system testing as shown in the Figure 7.1 below. In Figure 7.1 the arrows from the top of the boxes indicate the normal sequence of testing. The arrows returning to the previous box indicate that previous testing stages may have to be repeated because of some problems. The stages in the testing process are:

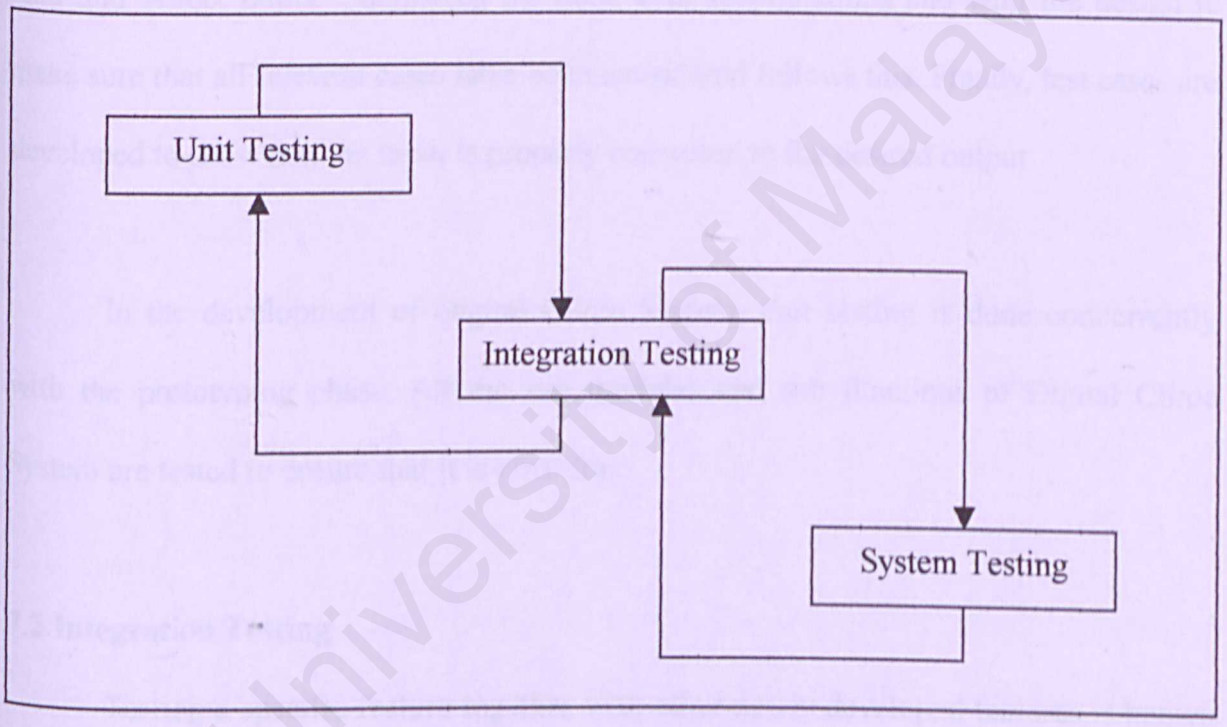

Figure 7.1: Testing Stages

7.1 Unit Testing

Historically, quality software is relied on testing each function or module. This practice called unit testing, which is extremely time-consuming. Unit testing verify that the component functions properly with the types of input expected from studying the component's design.

For Digital Clinic System, unit testing was done during the coding phase. The first step is to examine the program code by reading through it, trying to spot algorithm, data and syntax faults. Comparing the code with specifications and with the design to make sure that all relevant cases have been considered follows this. Finally, test cases are developed to show that the input is properly converted to the desired output.

In the development of Digital Clinic System, unit testing is done concurrently with the prototyping phase. All the sub modules and sub functions of Digital Clinic System are tested to ensure that it is error free.

7.2 Integration Testing

Testing a specific feature together with other newly developed features is known as in integrating testing. It is a systematic technique for constructing the program structure while conducting tests to uncover errors associated with interfacing. The objective is to take unit tested modules and build a program structure that has been dictated by design. This testing will ensure that the interfaces such as the module calling sequence in Digital Clinic System are arranged correctly.

In Digital Clinic System, an incremental integration strategy, the bottom-up integration and regression testing approach are used. In other words, when the individual components are working correctly and meet the objectives, these components are combined into a working system. Testing the interface of two components explores how components interact with each other.

The incremental integration is the antithesis of the high bang approach. Digital Clinic System's program is constructed and tested in small segments, where errors are easier to isolate and correct; interfaces are more likely to be tested completely. Error will be corrected before processing to the next integration.

7.3 System Testing

The last testing procedure done is system testing. Testing the system is different from unit testing and integration testing. Its objective is to ensure that the system does what the users want it to do.

System testing is designed to reveal bugs that cannot be attributed to individual component, or to the interaction among components and other objects. System tests study all the concerns issue and behaviors that can only be exposed by testing the entire integrated system or major part of it.

The Digital Clinic System is tested whether it meets the specific performance testing. Data integrity testing is used to verify that the data is stored in a manner where it

is not compromised under updating, restoration or retrieval processing in Digital Clinic System.

Chapter 8: System Evaluation and Conclusion

As this project has to be done within a limited time, a lot of technical issues needed to be resolved and also a lot of problems had been encounter during the development of this system. Solutions have been sought during the time of developing and testing, via research and studies such as the system available in the Internet and samples codes from the reference books. Trial and error technique is using during coding phase in order to solve the problems. As a result, by encountering with these problems have been proven to be valuable learning experience.

8.1 Problems and solution during system studies and analysis.

8.1.1 Determining project Scope

Due to the time frame given, it was impossible to incorporate too many features into the system. So, building a full-fledged system is merely impossible within the given time frame. Inexperience with the current technologies and particular scripting language is another hindrance to implement true workable registration procedure.

A number of discussions were held with project supervisor to outline the scope of the project to be developing during the initial stages of the project.

8.1.2 Difficulties in choosing a programming language

There is some well-known software tools available in the market that can be use to develop a web application as stated in the previous chapter. Choosing a suitable tool

was a critical process as all tools have their strengths and weaknesses. In addition, the availability at the required tool for the development was also a major consideration.

So seeking advises and views from project supervisor and also some of the course mates whom engaging in similar projects is carried out. After many references, studies and surveys, ASP and VBScript are chosen prior to the short time span available to develop this web-based Digital Clinic System. Therefore, all of the chosen languages are the most suitable programming languages as it incurs shorts learning curves.

8.1.3 Inexperience in Developing Web based Programming

Since there was no prior knowledge of programming in ASP and VBScript, there was an uncertainty on how to organize the structure and codes during the coding process. This new programming language was never taught before and to implement such application requires a fair grasp of the language. As there is no prior knowledge in programming in a web-based environment, a lot of studies need to be done in short time span. Besides programming concepts for web application is quite different from the traditional way of programming.

Most of the problems faced were manageable through surfing the Internet for related materials (source code) and referring to the reference books. When these cannot solve a problem two ways, discussions with course mates are done. Trial and error technique is using during the coding phase.

8.2 Evaluation by End User

I was inviting users to use Digital Clinic System to test this system. These evaluations consist of individuals with differences background. These users are satisfied because they can use a computerized system such as Digital Clinic System compare to traditional system.

8.3 System Strength

- **Staff**
  - For security purpose – an authorized administrator that has his own username and password can use system.
  - Authorized administrator can update, add, and delete records.
  - Use of search buttons to administrator fine the records.
  - Easier to update relevant record of user that register with this system.
  - Can avoid from data lost.
  - Can check appointment easily by doctor.

- **User**
  - To easier user registration as an authorized user.
  - Can less registration costs by online registration system.
  - Set an appointment through online can easy the user.
  - Provide a diagnosis online to the user.

8.4 Future Enhancements

- In the future, use of Multimedia Flash is use for better interface.
- Easier and user friendly of user interface.
- Arrange of pages are more consistent.
- Provides help wizard.
- Add more functions to user such as user can check their health records.
- Provide a feedback form to user – the use of electronic mail to interact with user system.

8.5 Experience and Knowledge

- Even though, a short time that had been given to learn the programming language but I could still develop the Digital Clinic System following to my knowledge and understanding.

- This system tests my patience and sincerity to make an effort to goal Digital Clinic System's objectives and fulfill user needed.

- This system gives a meaningful of experiences and makes me confident to undergo in carrier life.

8.6 Summary

After check this report, I hope the users are satisfied with this research and documentation. I will never forget to all effort and help that contributed from the persons who involve in my project. I believe that if be given more time, may be I can produce a better system. Anyway, thank to God because I have developed a system with my effort and others.

In conclusion, Digital Clinic System has achieves goal of the objectives and I hope this documentation will explain more detailed about Digital Clinic System.

Thank you.

Table of Content

List of Figures

User Manual

Introduction

Digital Clinic System is an user friendly system which is easy to learn and use, where all of the function in this system can be easily executed by a simple point and click on the available function button and hypertext link. In addition, all the system functionalities are meaningfully and clearly descriptive.

This manual provides a guideline for users about all the functionalities available in the system with some simple execution steps. This user manual includes the following part that will be discuss later:

i. Administrator Module

ii. User Module

iii. Doctor Module

Hardware Requirement

- Personal Computer, with Intel Celeron processor 333MHz or higher.
- 64MB of RAM
- 3GB of hard disk space or higher
- 15" Digital Monitor
- Keyboard, mouse as input devices.

Software Requirement

- Internet Explorer for the user interface.
- Windows 95, Windows 98, Windows 2000 or Windows NT Operating System.

Getting Started with Digital Clinic System

Digital Clinic System is a web-based system that no needs any installation process before running it. What we need to do is connect to the Internet and then access the URL of Digital Clinic System. Anywhere, before accessing to Digital Clinic System, please make sure that your computer meets the minimum hardware and software requirements, which stated in the previous statement.

Starting Digital Clinic System

For starting use Digital Clinic System, you have to type the following URL into the URL location:

URL: http://localhost/Clinic/index.htm

As a successful result of browsing to the URL above, the website of Digital Clinic System will be display on your computer monitor's screen as shown in Figure 1.0 below.

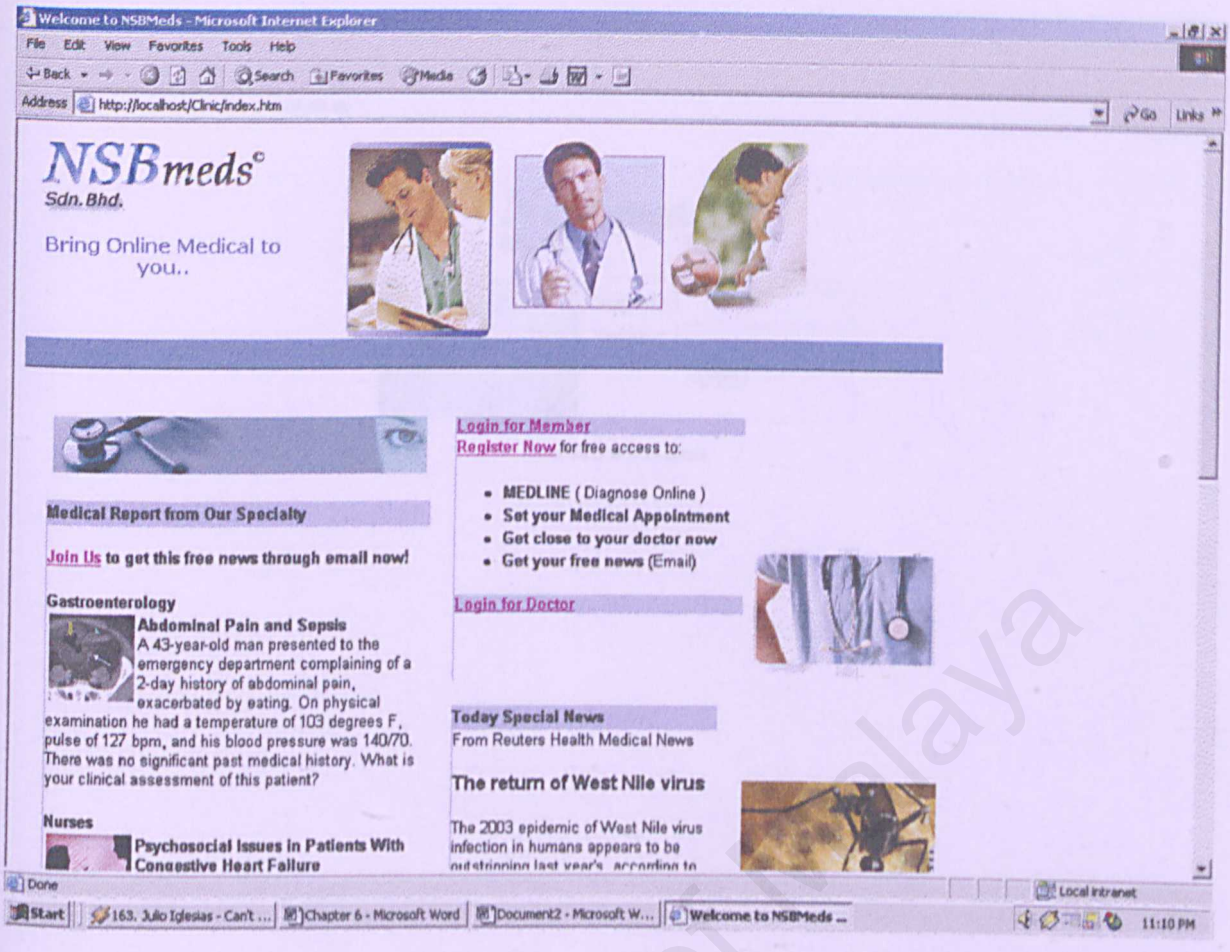

Figure 1.0: Main Page

In this website, you can select either you are an administrator, a user or a doctor who is going to login to the system and do the activities which are allowed for an authorized user.

Administrator Login

If you are an administrator, you may click on the "Admin Login" button at the bottom of the main page. Then, this will bring you to the Administrator Login Page as shown below.

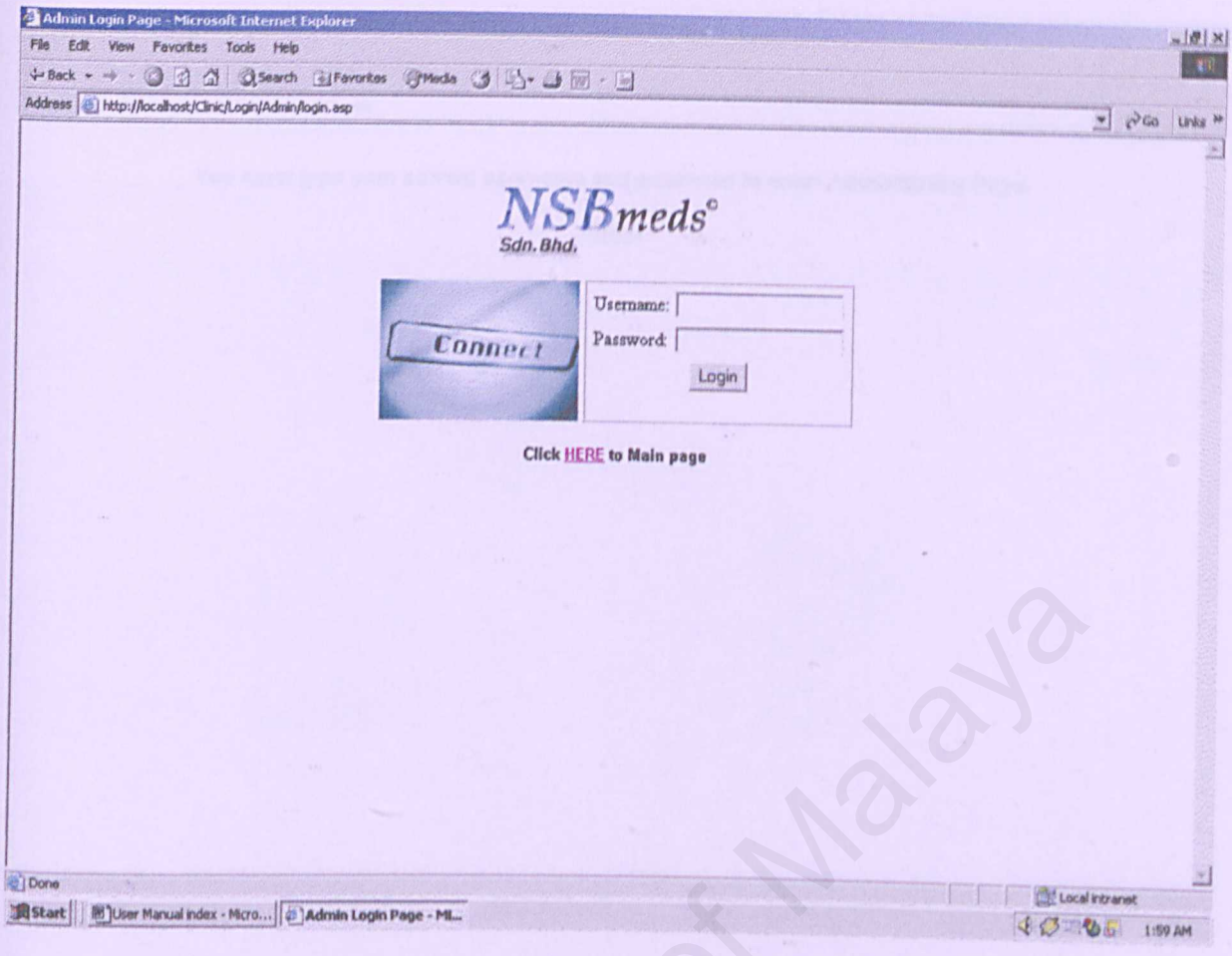

Figure 1.1: Administrator Login Page

This page enables you to key in your username and password. If you are an authorized user, the system will bring you to the Administrator Page where you can continue to do available activities in that module. If you click on the "Login" button without key in the username or password or both, an error message will display and you need to click "Retry" button to retype your correct username and password as shown in Figure 1.1(a).

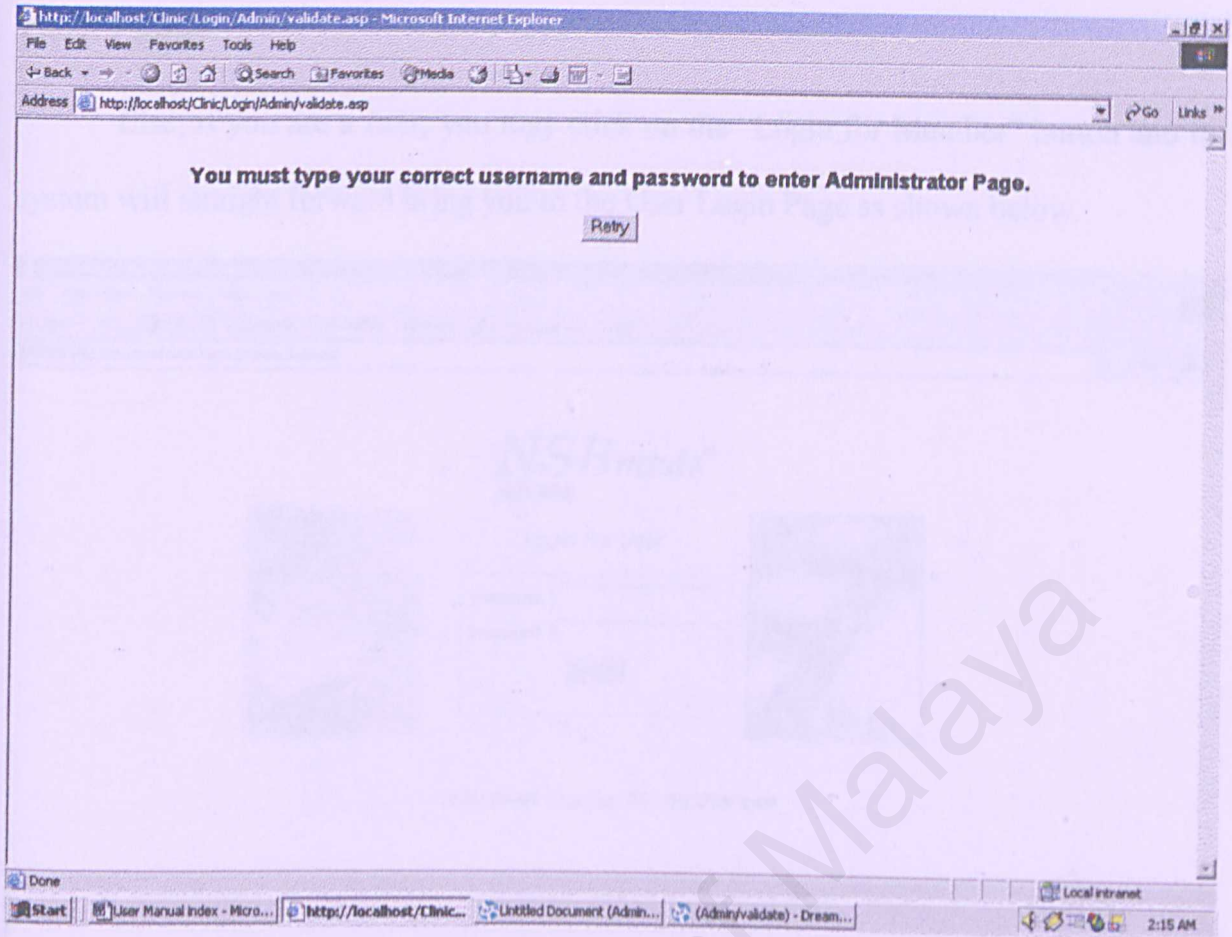

Figure 1.1(a): Validate Page

If you want to go back to the main page, you just have to click on the hyperlink at the Administrator Login. Also, a login-failed message will show on the Administrator Login Page if you enter an incorrect username or password or both of them.

User Login

Else, if you are a user, you may click on the "Login for Member" button and the system will straight forward bring you to the User Login Page as shown below.

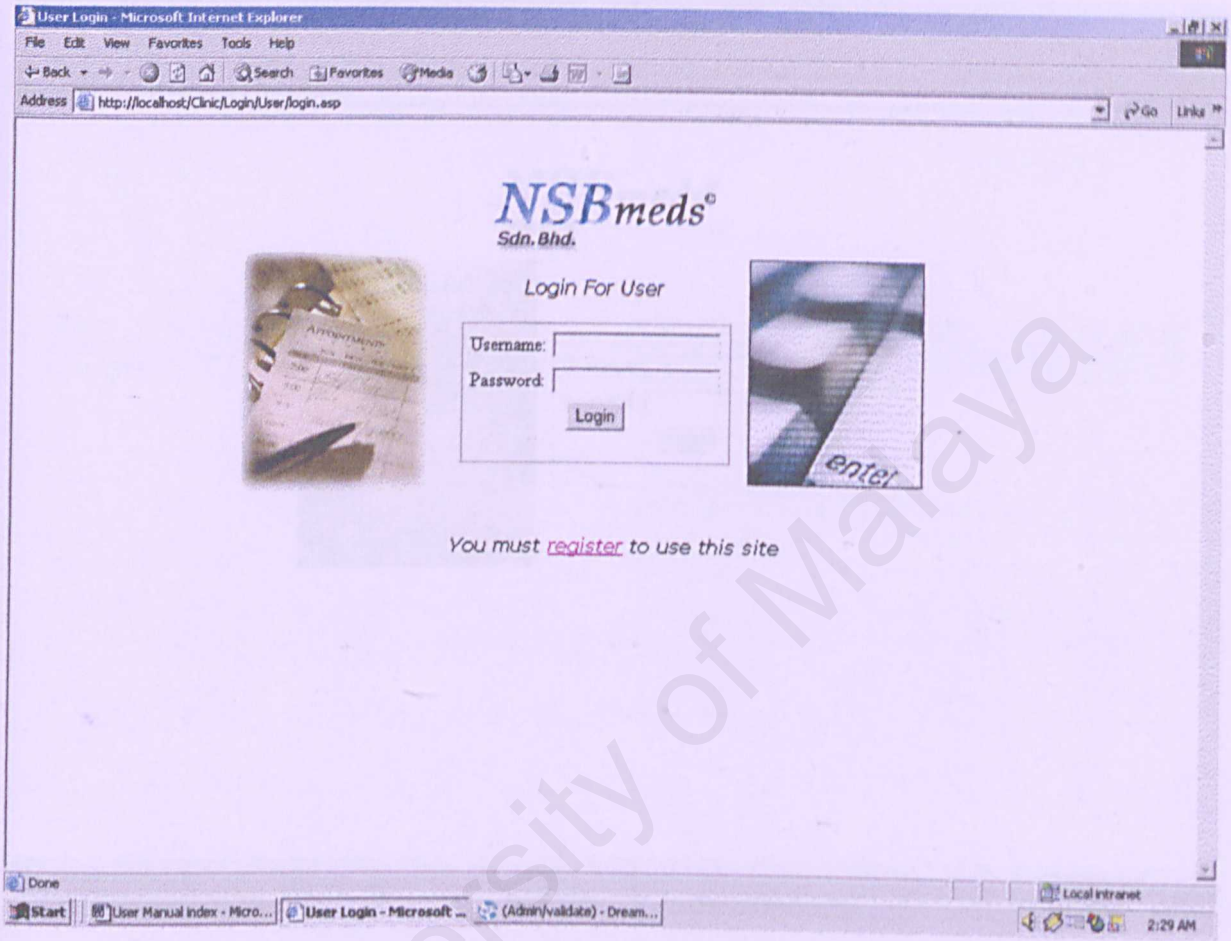

Figure 1.2: User Login Page

If you are an authorized user in the user module, the system will bring you to the user module where you can continue on your activities. Same with Administrator Login Page, an error message will display if you click on the "Login" button without key in your username or password or both of them. Also, a login-failed message will show on the User Login Page if you enter an incorrect username or password or both of them.

Doctor Login

If you are a doctor, you have to click on the "Login for Doctor" button and this will bring you to Doctor Login Page as shown in Figure 1.3.

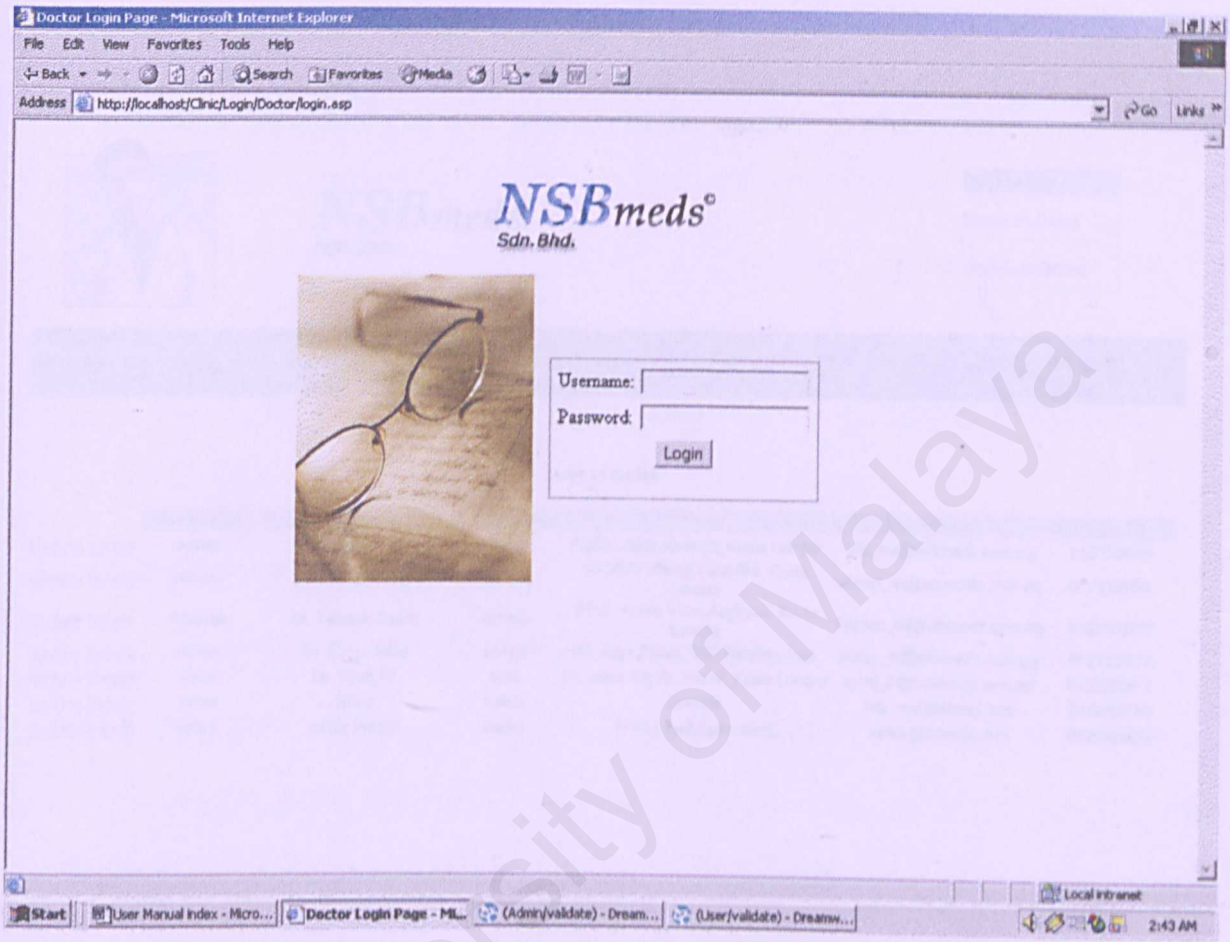

Figure 1.3: Doctor Login Page

If you are an authorized user in doctor module, this system will bring you to the doctor module and you can continue your activities. Same with both of the Administrator Login Page and User Login Page, the Doctor Login Page will show a login-failed message when you key in the wrong username and password.

Administrator Module

Once you correctly key in the administrator username and password, you will be bringing to Administrator Page as shown below.

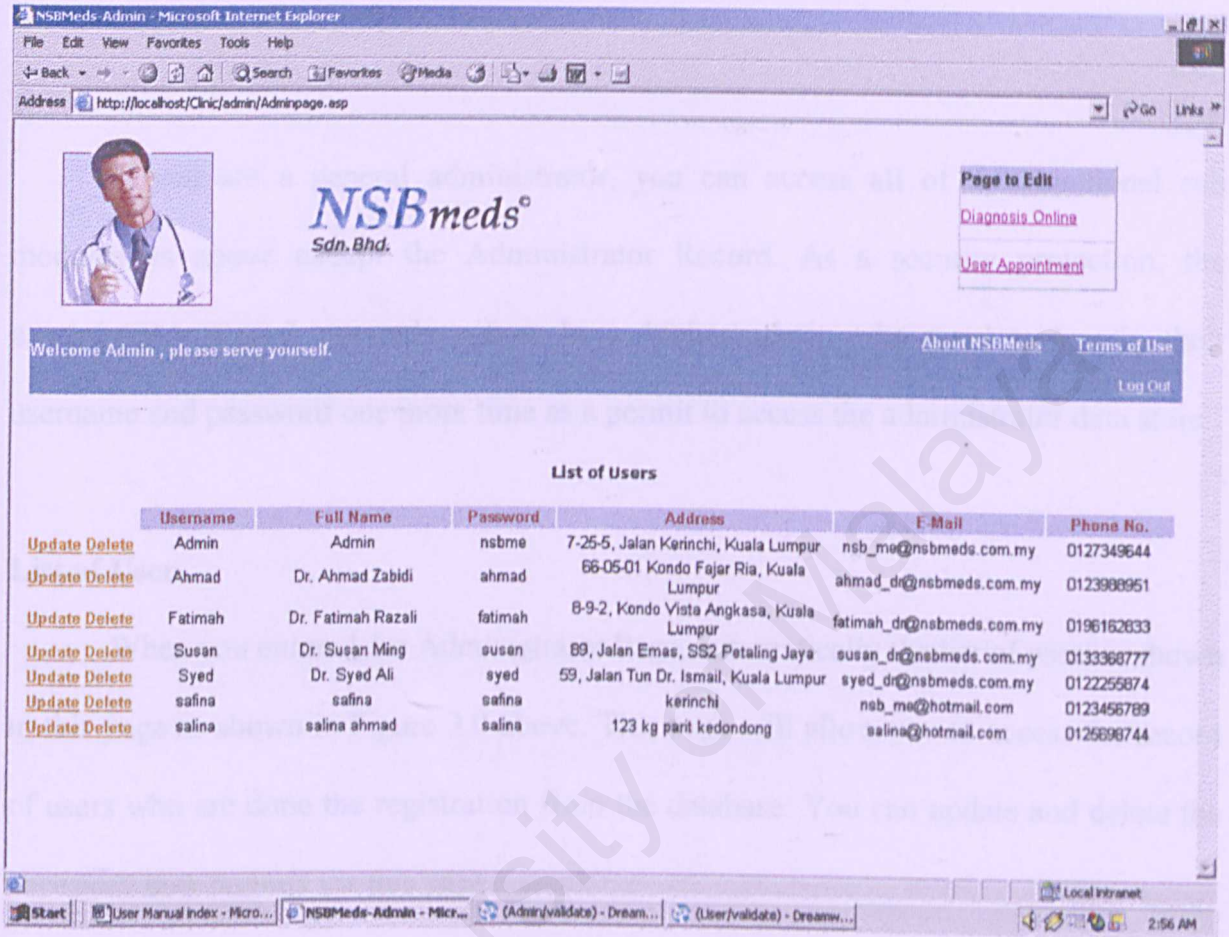

Figure 2.0: Administrator Page

The administrator module is divided into eight functional sub modules as listed below:

1. List of User
2. Update User
3. Delete User
4. Diagnosis Online

5. User Appointment
6. About NSBMeds
7. Terms of Use
8. Logout

If you are a general administrator, you can access all of the functional sub modules as above except the Administrator Record. As a security protection, the administrator record can only access by a higher admin who need to key in their username and password one more time as a permit to access the administrator data store.

List of User

When you entered the Administrator Page, automatically the list of users is shown in this page as shown in Figure 2.0 above. This page will allow you to access the record of users who are done the registration from the database. You can update and delete the necessary user records via this page.

Update User

When you click on the "Update" hyperlink, the following page will be displayed and you are allowed to update user detail.

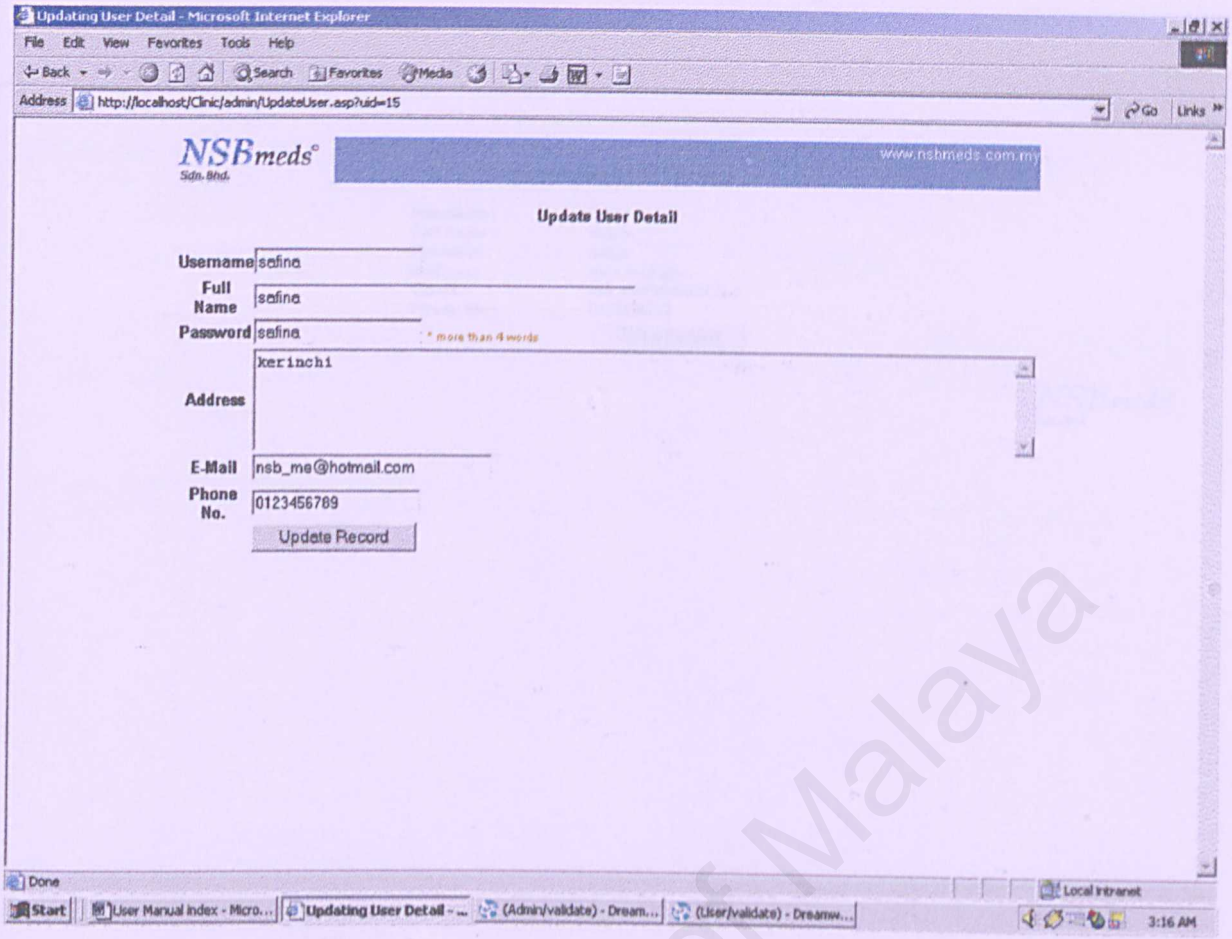

Figure 2.1: Update User

Then, when you click on the "Update Record" button, the user details automatically have been updated and will be shown in list of user at Administrator Page.

Delete User

If you click on the "Delete" hyperlink on the Administrator Page, you will see the following page, which show a confirmation message before you delete the user record. If you are sure to delete the record, you just have to click on "Delete Record" button and the record will be deleted.

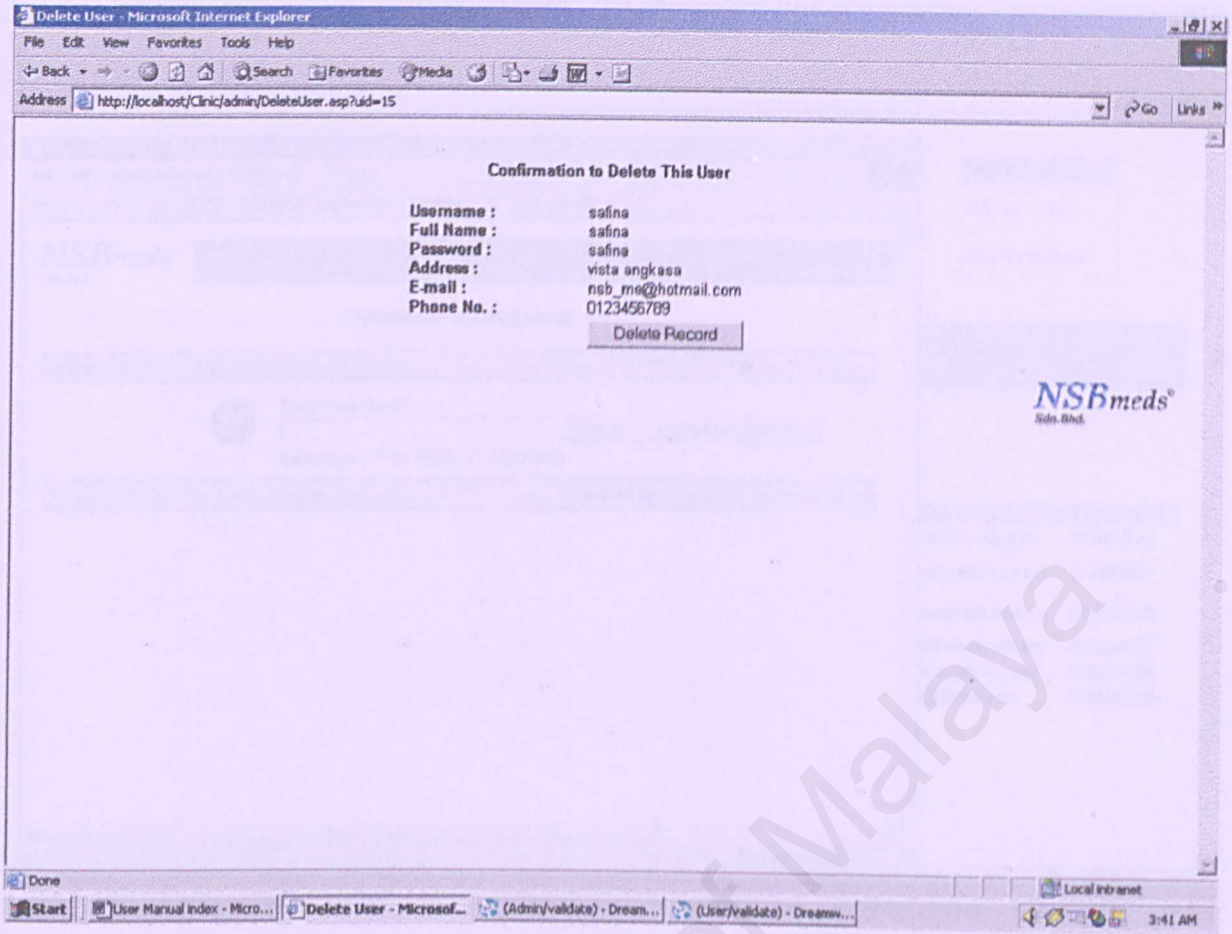

Figure 2.2: Delete User

Diagnosis Online

Once you click on "Diagnosis Online" hyperlink, a popup window will prompt as shown in Figure 2.3 and you are allowed to update the diagnosis.

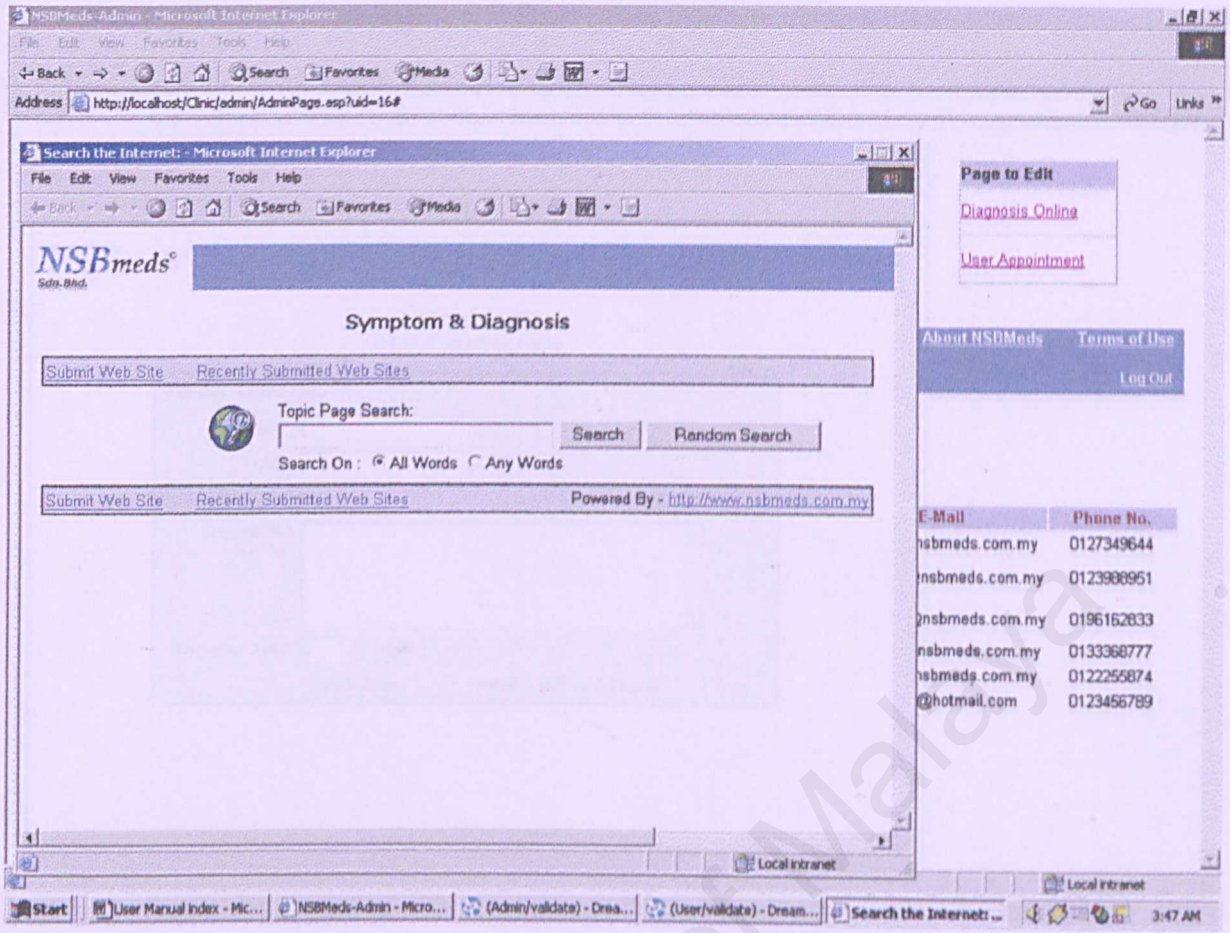

Figure 2.3: Diagnosis Online

In this popup window, you are allowed to search the related websites that are available in this system. Besides, you also can update the diagnosis online with add new URL to search engine by click on "Submit Web Site" hyperlink as shown below.

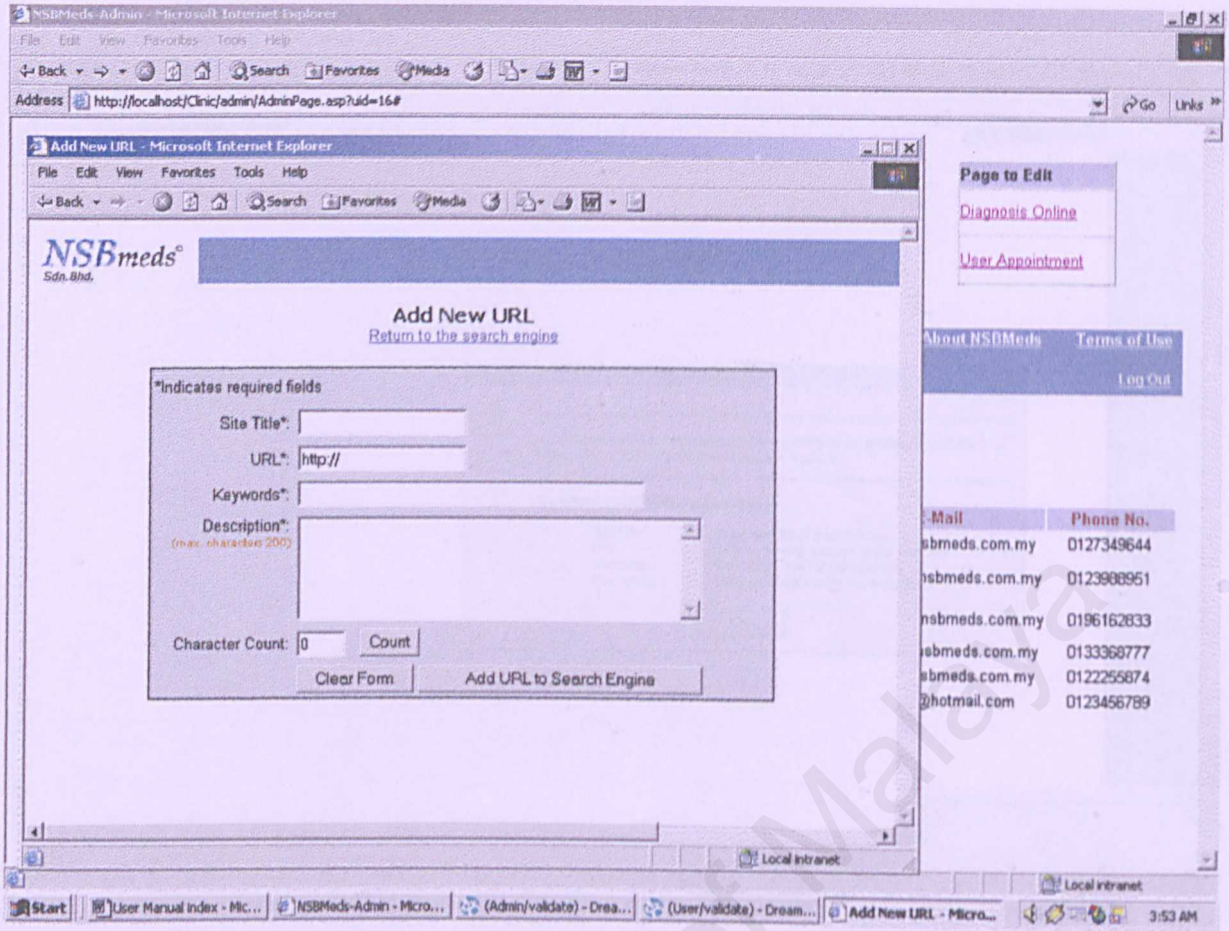

Figure 2.3(a): Add New URL

In this page you need to enter the title of the web site, the URL, the keywords for the web site and the descriptions of the web site. If you are not entering either which one of them, an error message box will be displayed as shown below.

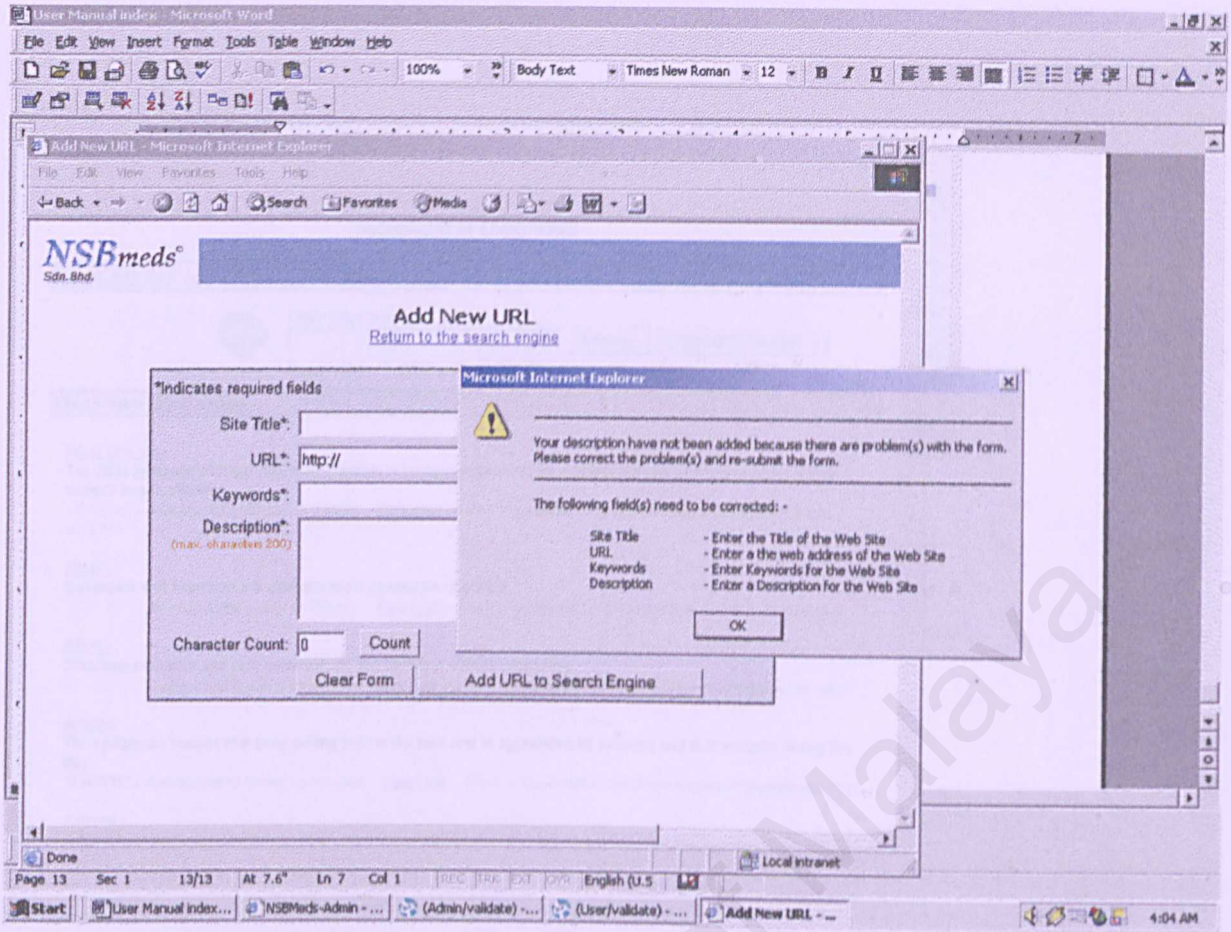

Figure 2.3(b): Error Message for Add New URL

Also, this page provides a hyperlink text to return back to search engine page. A list of recently submitted web sites are showed when you click on the "Recently Submitted Web Site" hyperlink text as in Figure 2.3(c). You also can click on number of stars you will give to the web site at "Rate Link" hyperlink text.

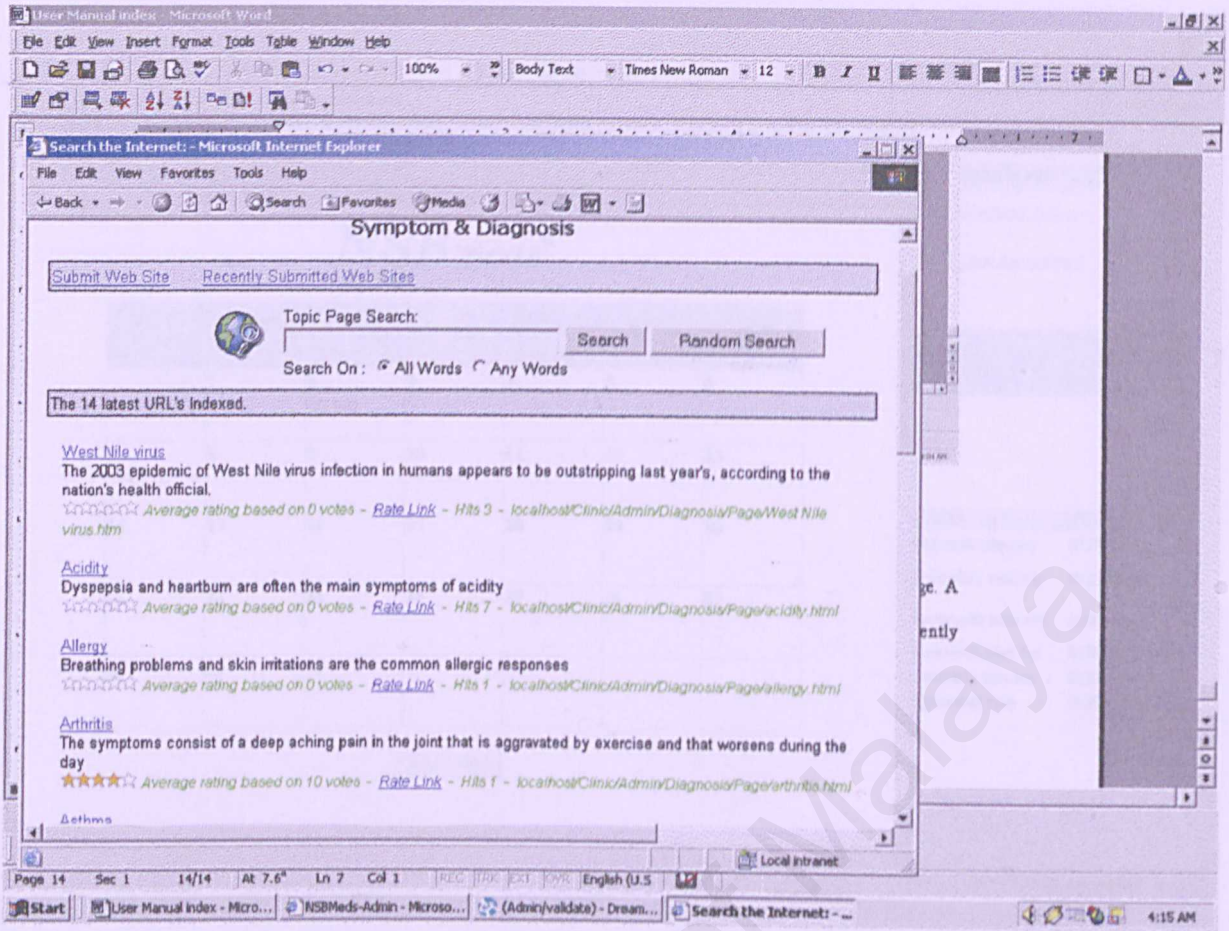

Figure 2.3(c): Recently Submitted Web Site

User Appointment

User appointment is one of the important sub modules for Digital Clinic System besides the diagnosis online. User appointment allows you to add user appointments with doctors and update or delete it. The user appointment popup window will prompt when you click on "User Appointment" hyperlink text in Administrator Page as shown below.

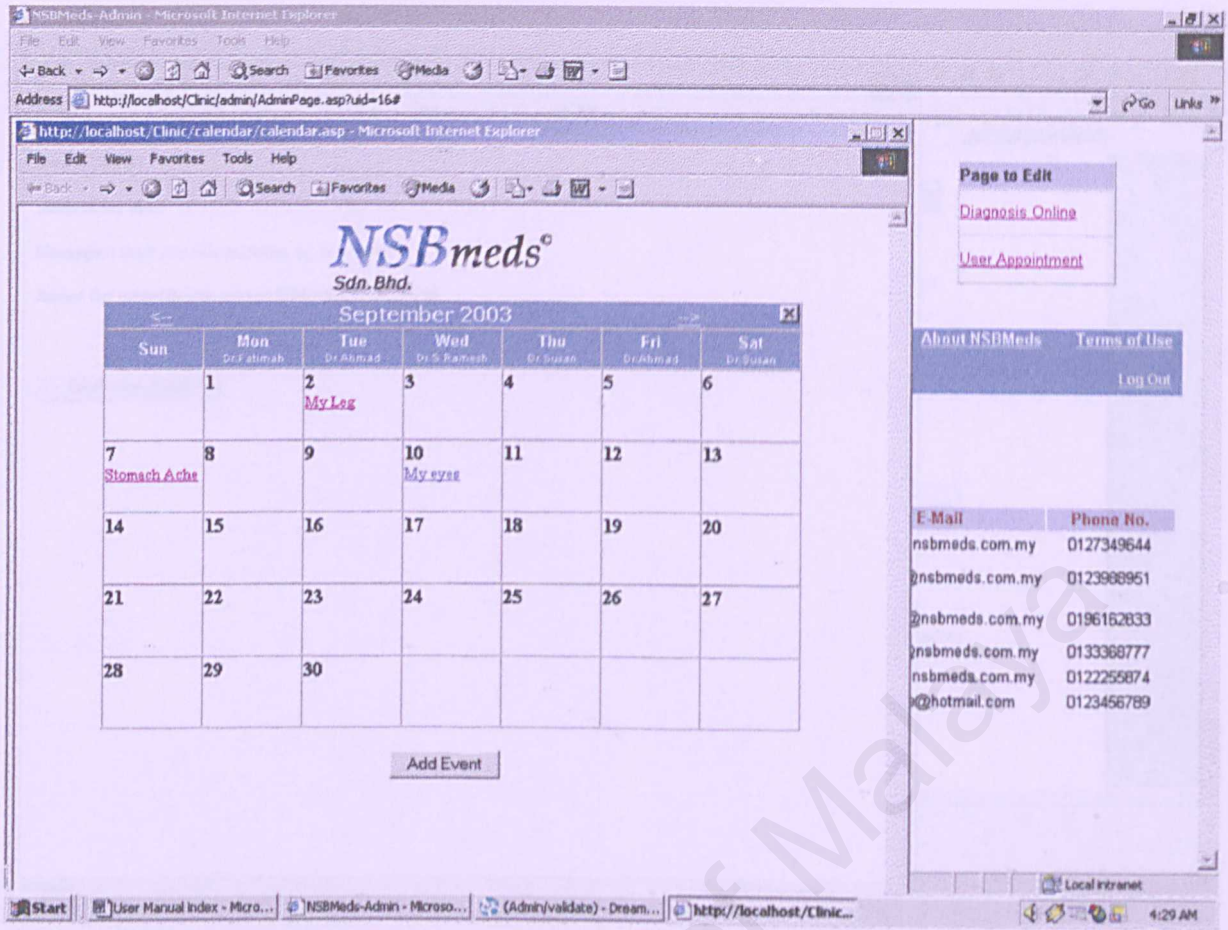

Figure 2.4: User Appointment

The appointments that had been made by user are display in the popup window and you are allowed to click it to edit or delete the appointments as in Figure 2.4(a) and Figure 2.4(b)

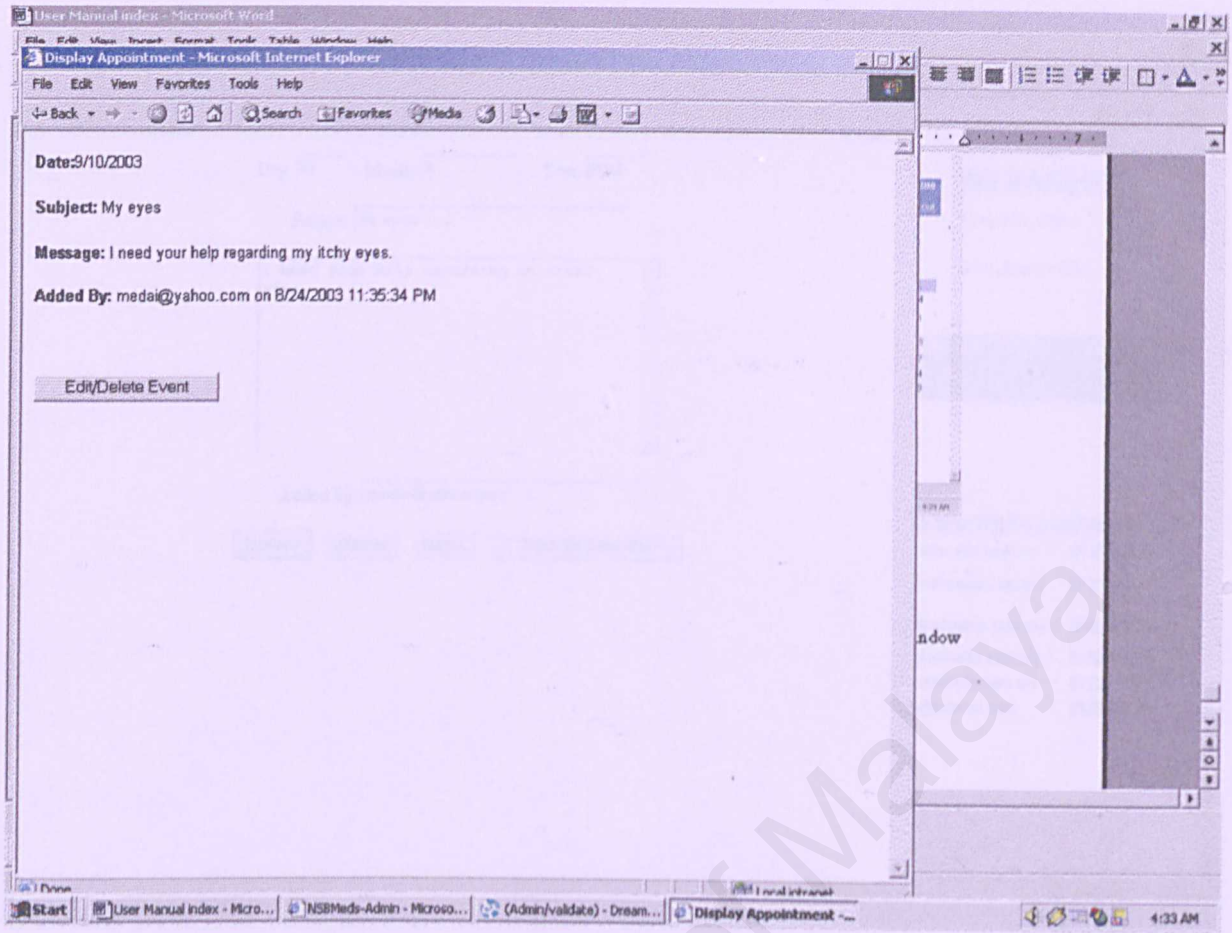

Figure 2.4(a): Edit or Delete User Appointment

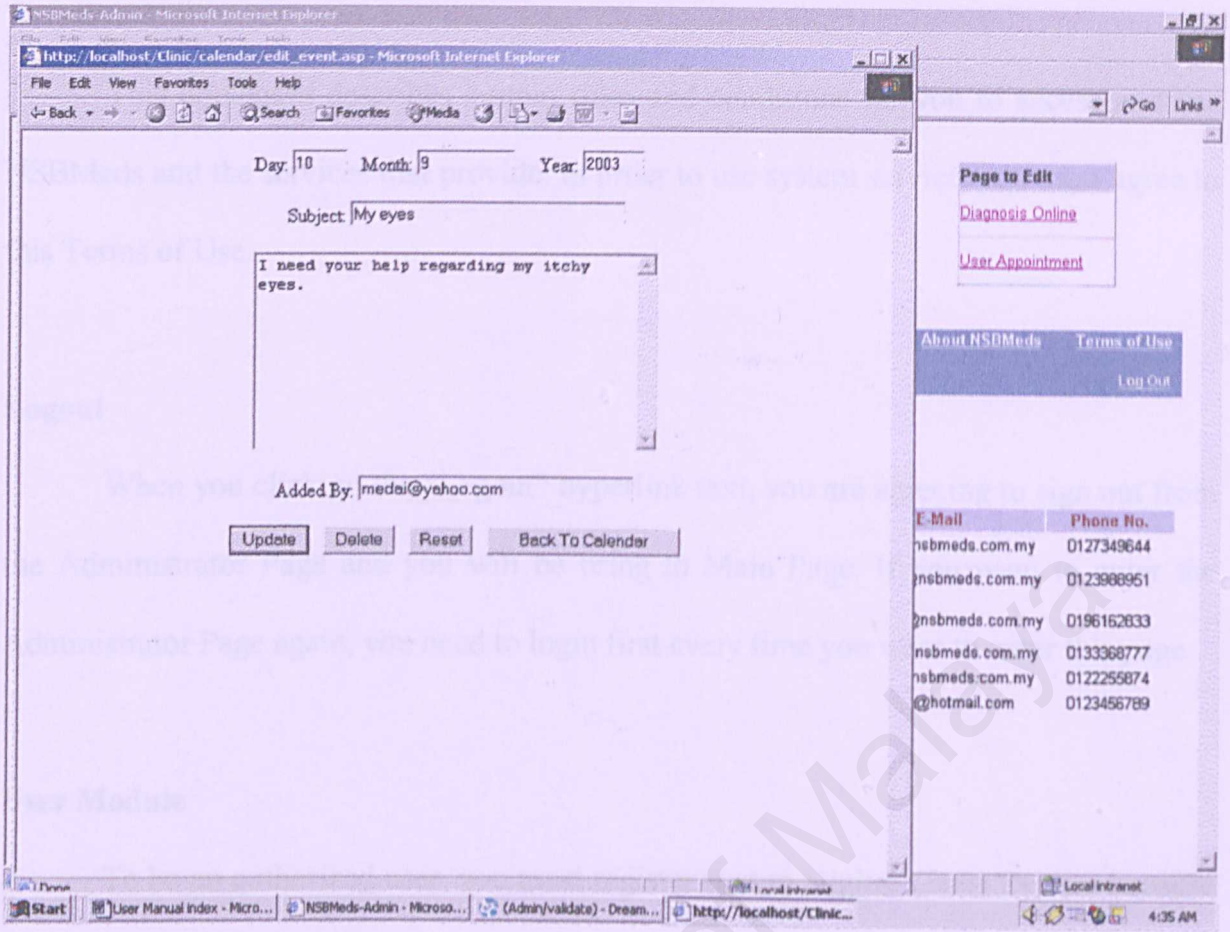

Figure 2.4(b): Update or Delete User Appointment

About NSBMeds

About NSBMeds is a description about mission, contents and organization of Digital Clinic System. This page also accompanied with email and phone number to contact the editors. You also can access this page by clicking the "About NSBMeds" hyperlink text at the Main Page, User Page and Doctor Page.

Terms of Use

This document describes system rules and conditions for you to access and use NSBMeds and the services that provide. In order to use system service, you must agree to this Terms of Use.

Logout

When you click on the "Logout" hyperlink text, you are agreeing to sign out from the Administrator Page and you will be bring to Main Page. If you want to enter the Administrator Page again, you need to login first every time you want to enter this page.

User Module

To be an authorized user, you must register first to Digital Clinic System because this system is providing the benefit of system only for the authorized user. In the Main Page, you must click on the "Register Now" hyperlink text to register and the registration form for new user is shown as below.

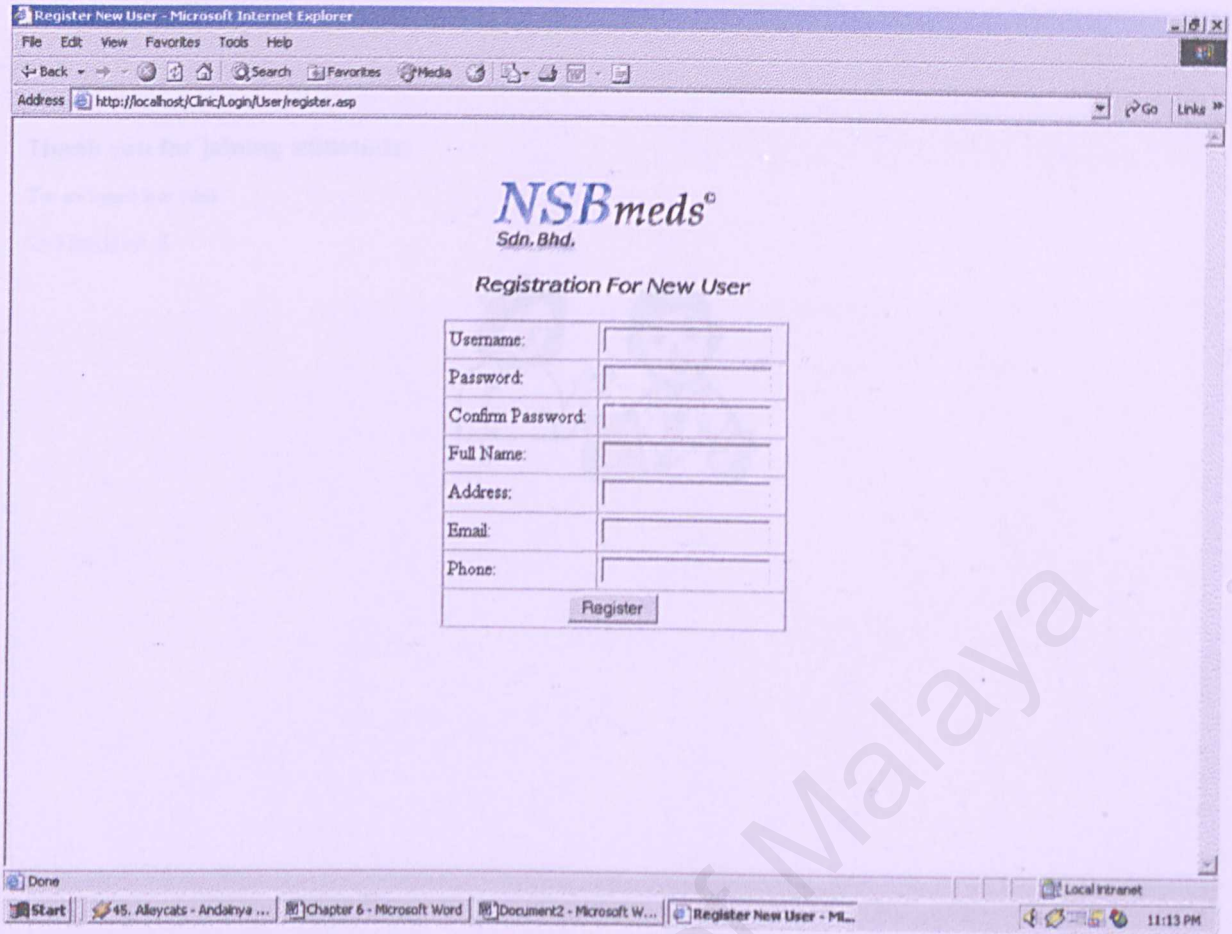

Figure 3.0: Registration Form for New User

When you have successfully registered to this system, a message is shown in Figure 3.0(a) and if your username that you entered has already been taken, a message will be displayed in the registration page as shown in Figure 3.0(b) below.

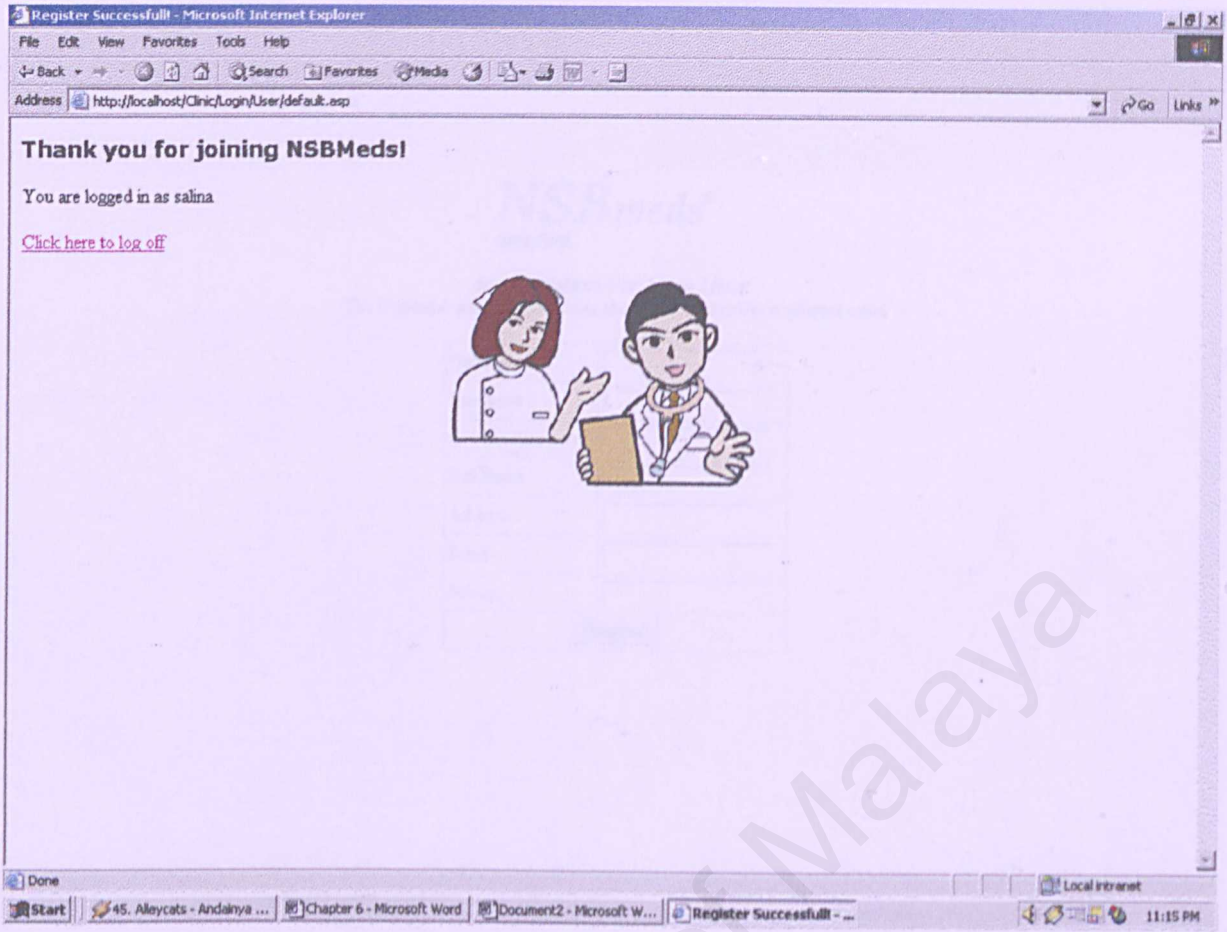

Figure 3.0(a): Registration success

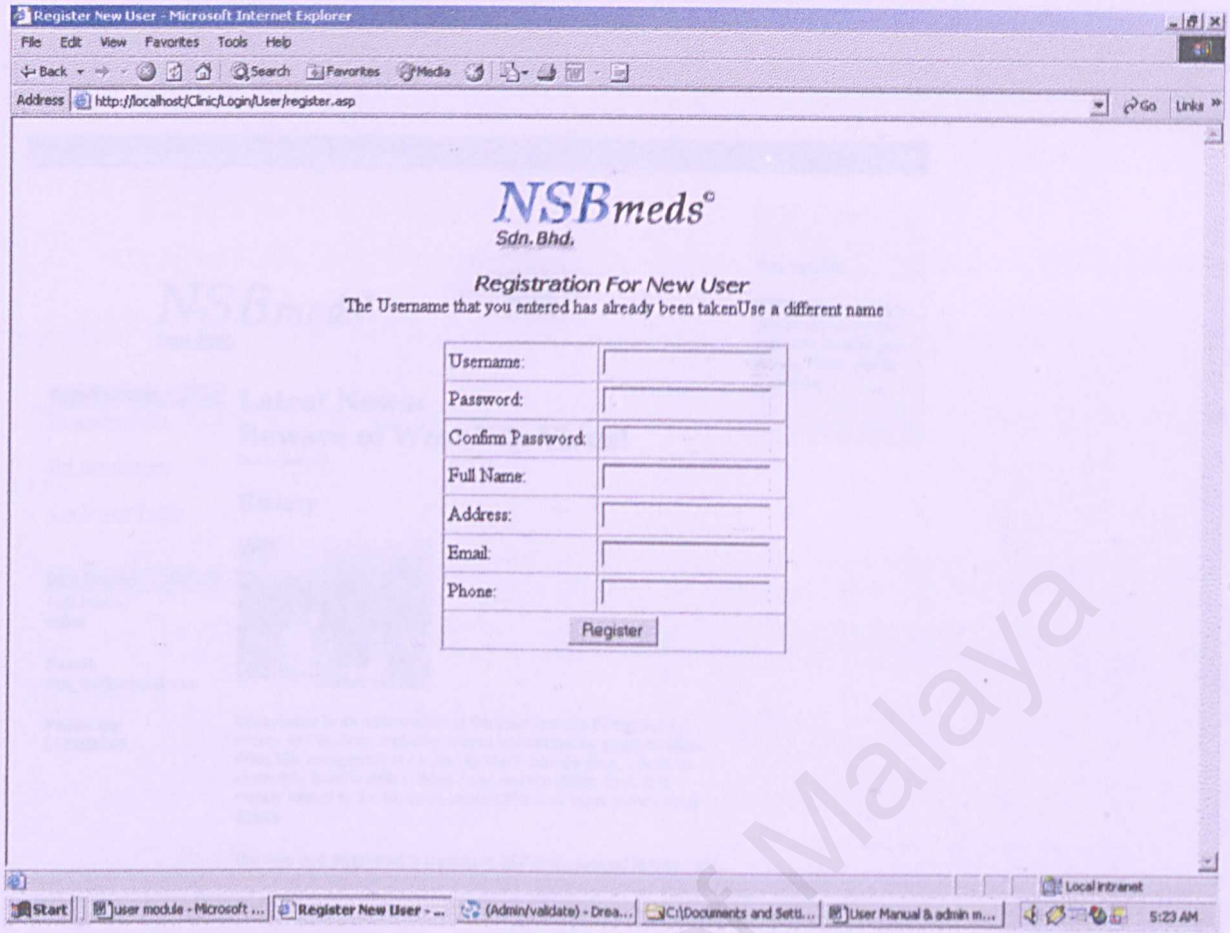

Figure 3.0(b): Error in Entering Username

Once you correctly key in the user's username and password, you will be bringing to User Page as shown below.

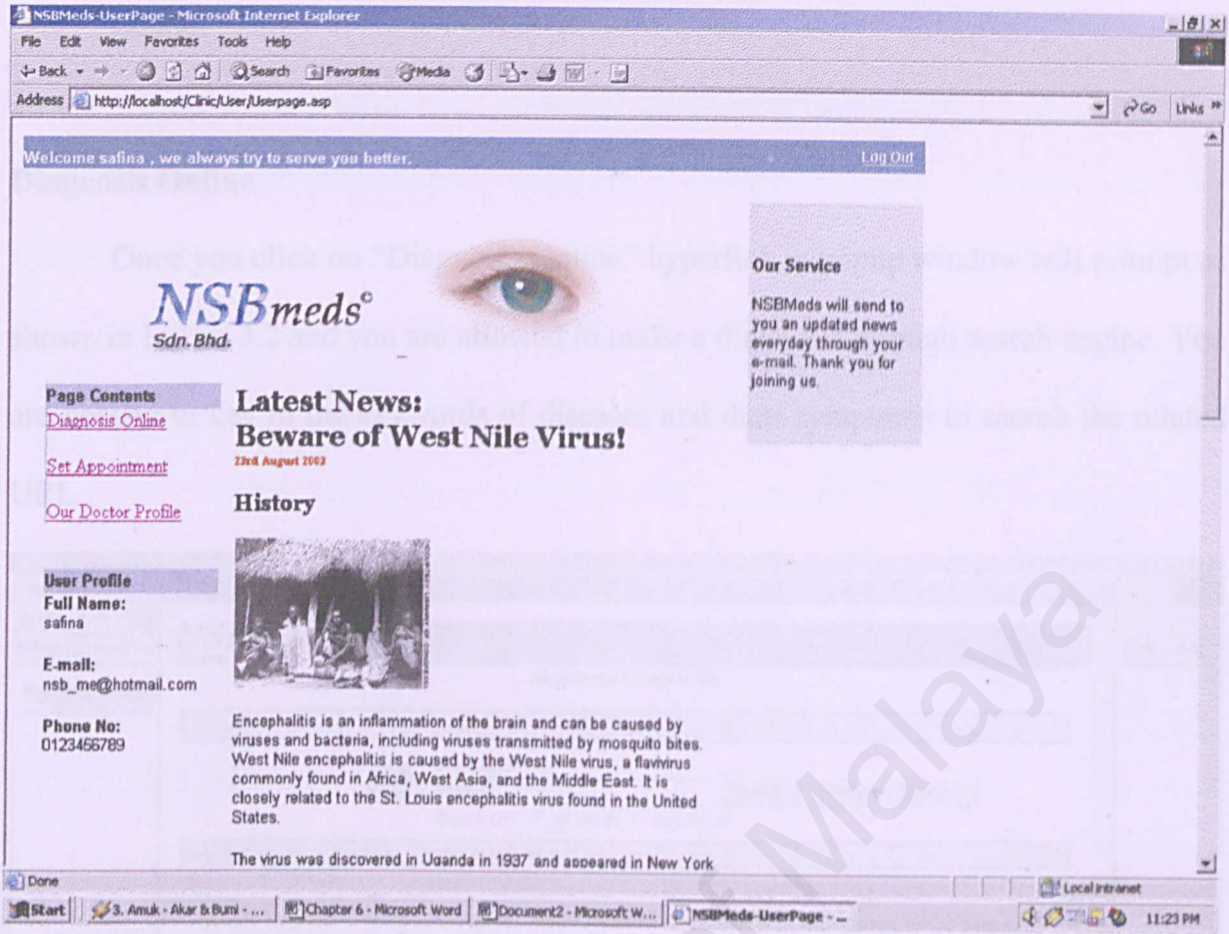

Figure 3.1: User Page

A welcome note will be displayed on the top of page when an authorized user entered User Page. The user module is divided into seven functional sub modules as listed below:

1. Diagnosis Online
2. Set Appointment
3. Doctor Profile
4. About NSBMeds
5. Privacy & Ethics
6. Terms of Use

7. Logout

Diagnosis Online

Once you click on "Diagnosis Online" hyperlink, a popup window will prompt as shown in Figure 3.2 and you are allowed to make a diagnosis through search engine. You are needed to key in the keywords of diseases and their symptoms to search the related URL.

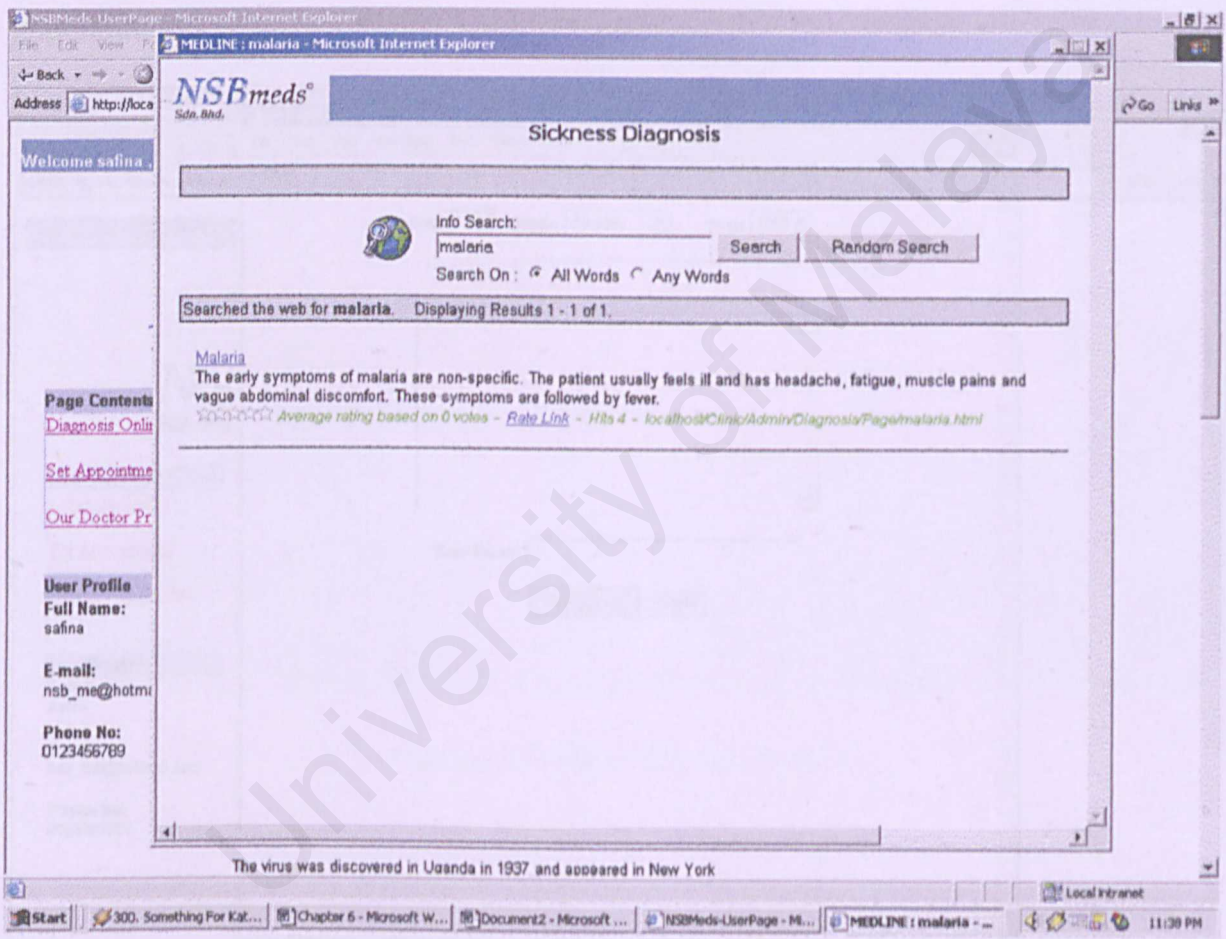

Figure 3.2: Diagnosis Page for User

Set An Appointment

Digital Clinic System provides a module that allows user to set an appointment with a doctor. As I mention before, users need to register first to get the benefit from this system. Methods of make an appointment are same with methods that I describe in Administrator Module. The difference application between user and administrator is user only can make appointment and view the appointment but the administrator available to add, update, view and delete appointments. Figure 3.3 shown form to make an appointment.

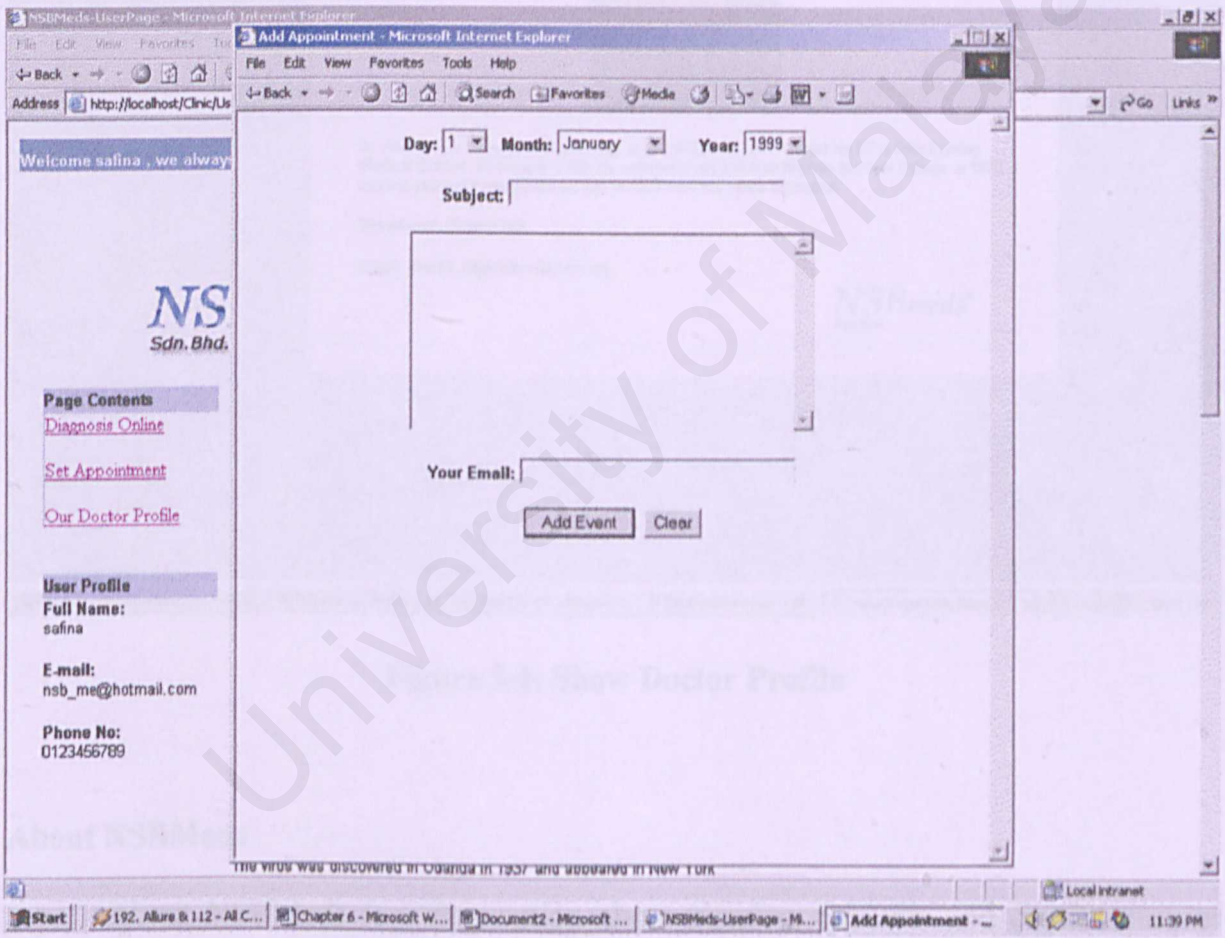

Figure 3.3: Make Appointment

View Doctor Profiles

An authorized user is allowed to view doctor profiles detailed. Figure 3.4 below shown the Doctor Profile Page.

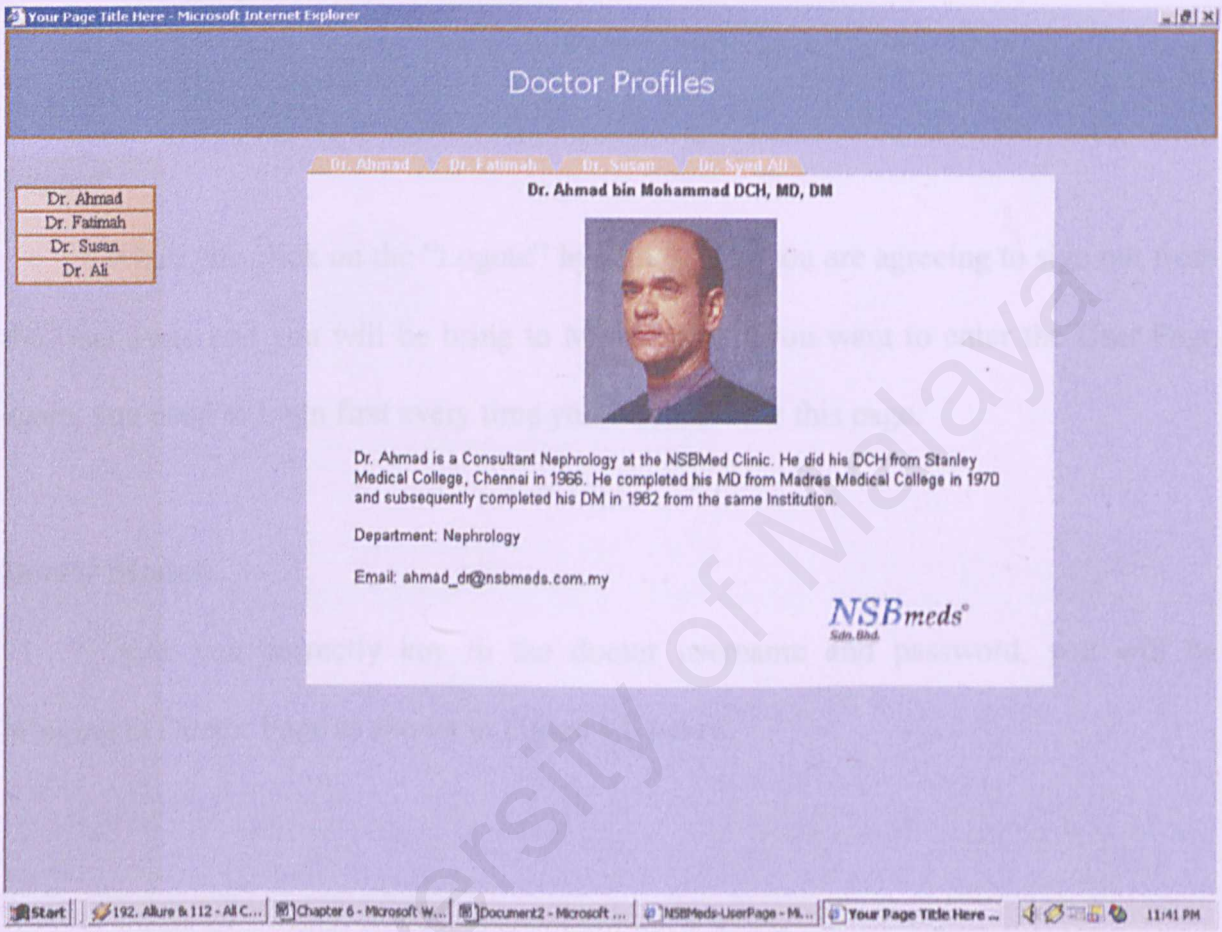

Figure 3.4: Show Doctor Profile

About NSBMeds

About NSBMeds is a description about mission, contents and organization of Digital Clinic System. This page also accompanied with email and phone number to contact the editors. You also can access this page by clicking the "About NSBMeds" hyperlink text at the Main Page, User Page and Doctor Page.

Terms of Use

This document describes system rules and conditions for you to access and use NSBMeds and the services that provide. In order to use system service, you must agree to this Terms of Use.

Logout

When you click on the "Logout" hyperlink text, you are agreeing to sign out from the User Page and you will be bring to Main Page. If you want to enter the User Page again, you need to login first every time you want to enter this page.

Doctor Module

Once you correctly key in the doctor username and password, you will be bringing to Doctor Page as shown in Figure 4.0 below.

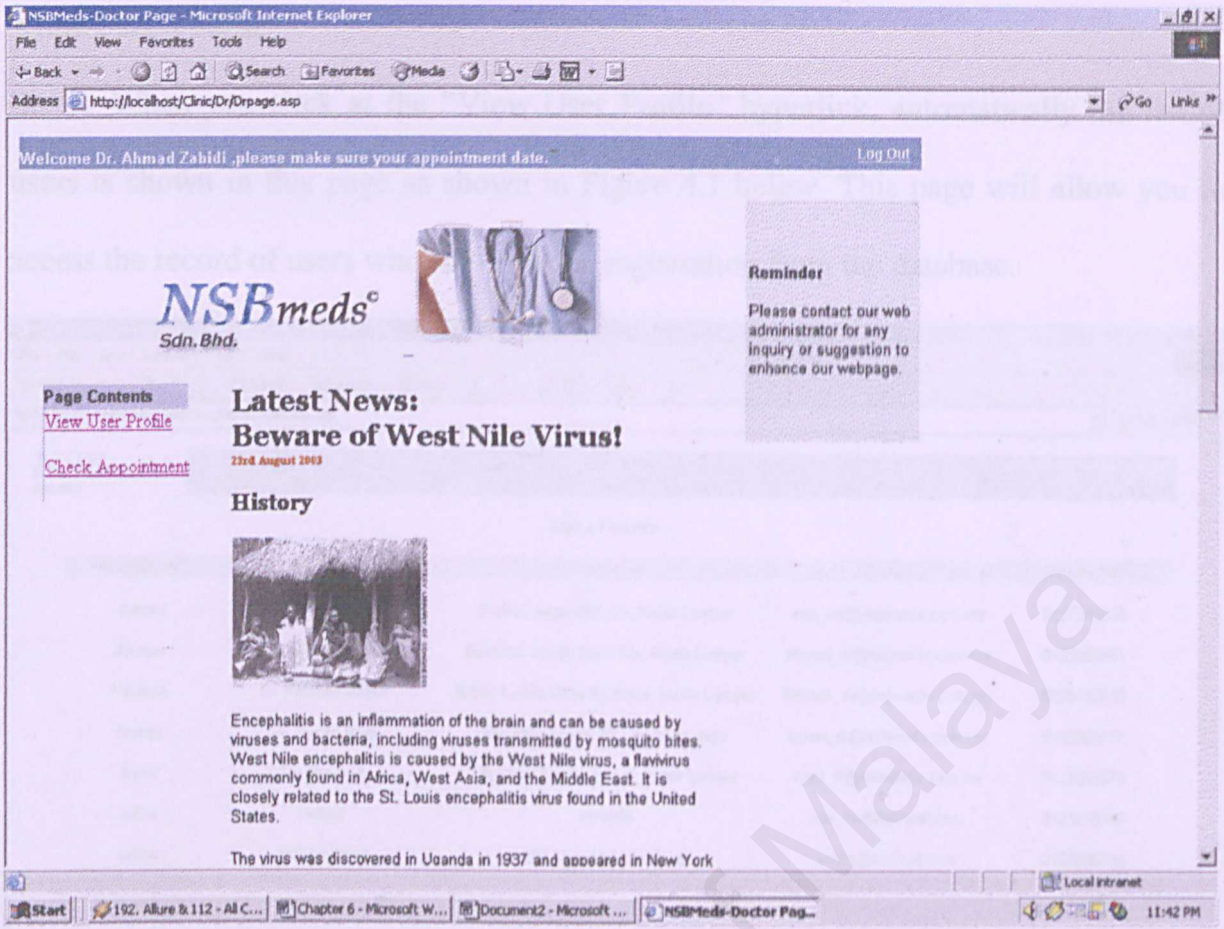

Figure 4.0: Doctor Page

A welcome note will be displayed on the top of page when an authorized doctor entered Doctor Page. The doctor module is divided into six functional sub modules as listed below:

1. View User Profile
2. Check Appointment
3. About NSBMeds
4. Privacy & Ethics
5. Terms of Use
6. Logout

View User Profile

When you click at the "View User Profile" hyperlink, automatically the list of users is shown in this page as shown in Figure 4.1 below. This page will allow you to access the record of users who are done the registration from the database.

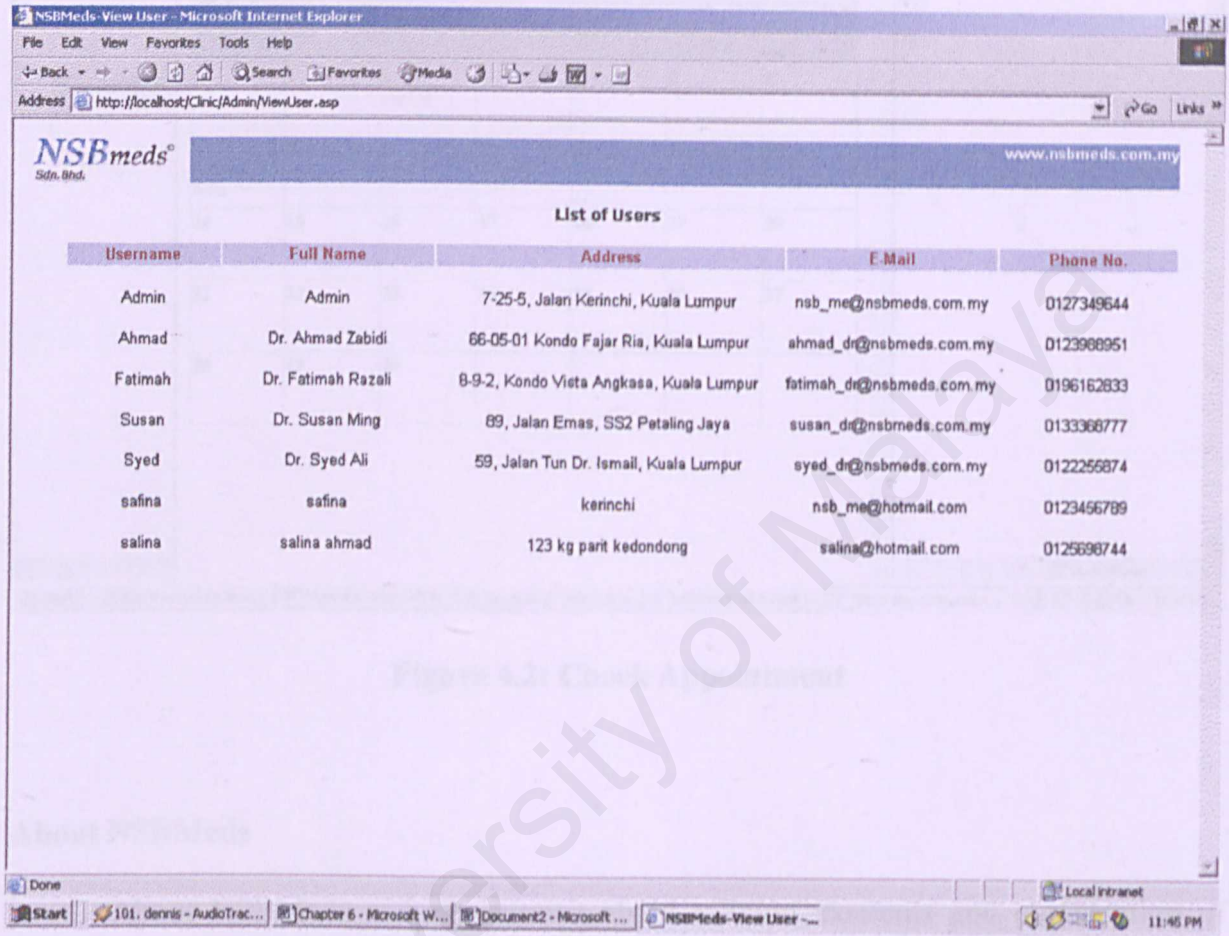

Figure 4.1: Show List of User

Check Appointment

You are allowed to check all appointment that had been made by users or administrators. It is can be done when you clicked at "Check Appointment" hyperlink as shown below. Pop up windows of calendar event will be prompt and then you can click at the link to view the appointment detailed.

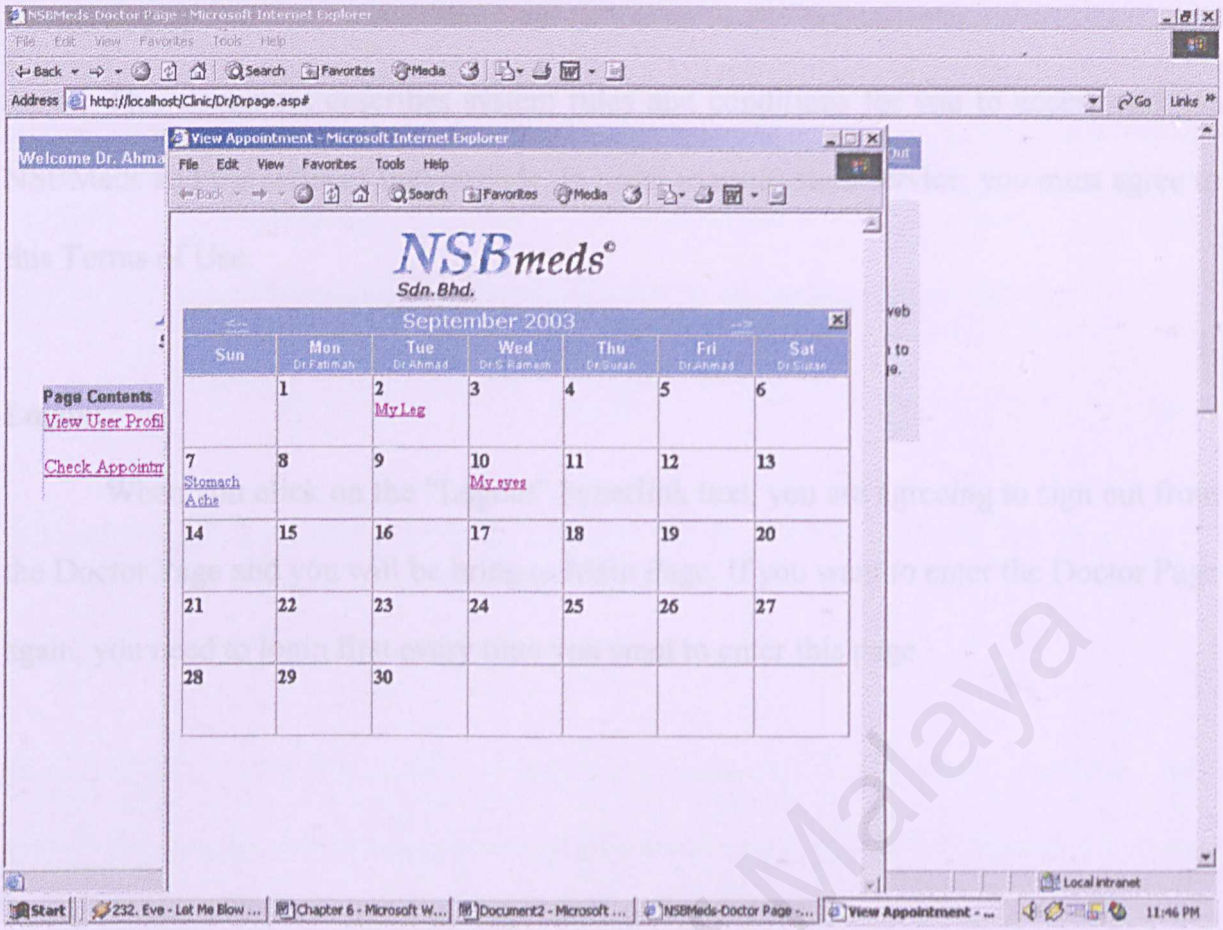

Figure 4.2: Check Appointment

About NSBMeds

About NSBMeds is a description about mission, contents and organization of Digital Clinic System. This page also accompanied with email and phone number to contact the editors. You also can access this page by clicking the "About NSBMeds" hyperlink text at the Main Page, User Page and Doctor Page.

Terms of Use

This document describes system rules and conditions for you to access and use NSBMeds and the services that provide. In order to use system service, you must agree to this Terms of Use.

Logout

When you click on the "Logout" hyperlink text, you are agreeing to sign out from the Doctor Page and you will be bring to Main Page. If you want to enter the Doctor Page again, you need to login first every time you want to enter this page.

References:

ROBINSON, A. (November, 2002) *UCLA Healthcare Integrated Website Project* [online]. University of California. Available from: http://infoshare.mednet.ucla.edu/news/nov02up.htm [Accessed 7 April 2003]

SOMMERVILLE, I. (2000). Software Engineering. 6th Edition. Addison Wesley Ltd.

SULLIVAN, J. (Jul 29, 2001). *Client/Server* [online]. TechTarget. Available from http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci211796,00.html [Accessed 10 April 2003]

KALAKOTA, R. (Aug 17, 1998) *What are the characteristics of client/server architecture?* [online]. Available from: http://www.faqs.org/faqs/client-server-faq/ [Accessed 10 April 2003].

TAYLOR, L. (Aug 17, 1998). *What is a Two-Tier Architecture?* [online]. Available from: http://www.faqs.org/faqs/client-server-faq/ [Accessed 10 April 2003].

TAYLOR, L. (Aug 17, 1998). *What is a Three-Tier Architecture?* [online]. Available from: http://www.faqs/client-server-faq/ [Accessed 10 April 2003].

SADOSKI, D. (Aug 2, 1997) *Client/Server Software Architectures-An Overview* [online]. Carnegie Mellon University. Available from : http://www.sei.cmu.edu/str/descriptions/clientserver_body.html [Accessed 10 April 2003].

PALANISWAMI, D., LYNCH, J., SHEVCHENKO, I., MATTIE, A., REED-FOURQUET, L., 2003. *Web-Based multi-Paradigm Workflow Automation For Efficient Health-Care Delivery* [online]. Barnes Road, Wallingford. Available from: http://www.chime.org/Education/Conference_Groups.html [Accessed 7April 2003]

APPAREO. (2003) *Clinic Administration* [online]. 1 Cornhill London, Appareo Ltd. Available from: http://www.appareo.co.uk/products/sh_prms.htm [Accessed 7 April 2003]

PRIMARY CARE DOCTORS' ORGANIZATION MALAYSIA. (17 June 2002). *PCDOMnet: About Us* [online]. Malaysia, PCDOMnet. Available from: http://www.pcdom.org.my/aboutus.htm [Accesed 7 April 2003]

CORKHILL, B. (2002) *Active Server Pages Forum* [online]. United Kingdom. Available from: http://www.webwizguide.info/forum [Accessed 27 August 2003].

CORKHILL, B. (2002) *Active Server Pages Forum* [online]. United Kingdom. Available from: http://www.webwizguide.info/asp/FAQ [Accessed 27 August 2003].

CORKHILL, B. (2002) *Active Server Pages Forum* [online]. United Kingdom. Available from: http://www.webwizguide.info/asp/faq/access_database_faq.asp [Accessed 27 August 2003].